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ON
RANGE LANDS
RE
ARTHUR W. SAMPSON

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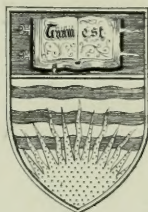


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LIVESTOCK HUSBANDRY ON
RANGE AND PASTURE

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WORKS OF ARTHUR W. SAMPSON

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Livestock Husbandry on Range and Pasture.

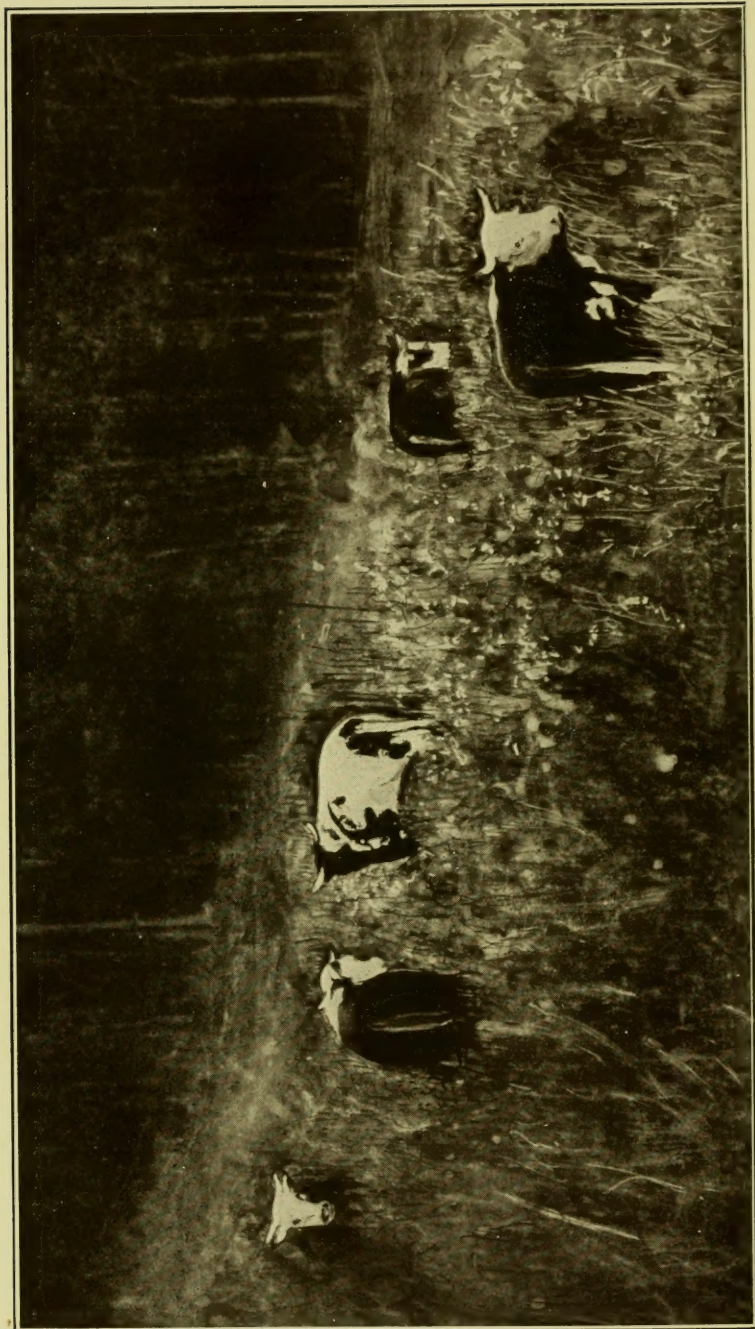
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(Frontis piece)

BREED AND PASTURE TO PRODUCE SUPERIOR QUALITY OF BEEF.

LIVESTOCK HUSBANDRY ON RANGE AND PASTURE

BY

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TO
The Livestock Associations of America
WHOSE
CONSTRUCTIVE AND ORGANIZED EFFORTS
ARE INSPIRING IN PRODUCERS
THE ADOPTION OF BETTER LIVESTOCK HUSBANDRY
ON PASTURE LANDS
THIS BOOK IS
CORDIALLY DEDICATED

PREFACE

This book is prepared as a companion volume to "Range and Pasture Management" and "Native American Forage Plants." The book of the first title deals with methods of revegetating pasture lands; the second, with the comparative value of the many native and introduced species of forage plants. The present work treats of the husbandry of the different kinds of livestock on range and farm pasture, and of the more important problems of economics concerned in such production.

It is well known that animals properly handled on grass make greater returns than on any other feed. For the first time there are here brought together in a single volume such important subjects as the most approved methods of livestock handling on different types of forage; the suitability of breeds of stock to climate and food plants; the habits and practical control of predatory animals and forage-destroying rodents; and the relation of livestock grazing to the propagation, preservation, and management of game animals.

The book is intended principally to provide systematic instruction for those who wish to train themselves as range technicians, and for those who intend to engage in livestock raising. Since the work also points out the many interests closely related to the grazing industry, the author hopes that it may lead those stockmen who have thought but little, or narrowly, on the subject to broaden their outlook in the interest of the public good.

The subject material is presented under four broad subdivisions:

Part One, "Range History and Livestock Improvement," traces the introduction and population of livestock on this continent and outlines the probable trend of our future meat supply; and it points out the most effective means of improving the quality of domestic foraging animals.

Part Two, "Pasture Husbandry of Sheep and Goats," is

unique in that it points out the most approved ways of handling livestock with respect to seasons of pasture use to insure a maximum amount of nutritious forage; discusses the adaptability of leading breeds of sheep and goats to both range and farm; it gives instruction in the judging of these animals and in their husbandry on rugged range and on farm pastures; and it suggests how losses from the more common diseases may be controlled.

Part Three, "Pasture Husbandry of Beef Cattle," devotes six chapters to the management of beef cattle on pastures, and treats the subject in the same general way as that of sheep and goats. In these discussions the management methods that have best stood the tests of practical use are emphasized.

Part Four, "Economics of Pasture Livestock," is concerned with the cost of raising and growing livestock, and presents a system of cost-keeping which is so thoroughly usable that any stockman should be able to adapt it to his conditions. Consideration is also given to the control of animals that prey upon livestock and rodents that destroy pasture forage; to the relation of wild animal life and recreation areas to livestock grazing; and finally, to the raising of reindeer as a range industry in the far North.

Although credit can not be given individually to the many colleagues who have so generously offered constructive ideas and suggestions during the preparation of the manuscript, the author wishes to express his sincere gratitude to all who in one way or another have increased the accuracy, hence usefulness, of the book.

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PART ONE

RANGE HISTORY AND LIVESTOCK IMPROVEMENT

LIVESTOCK HUSBANDRY ON RANGE AND PASTURE

CHAPTER I

THE LIVESTOCK INDUSTRY, MEAT CONSUMPTION, AND PROSPECTIVE MEAT SUPPLY

In all countries the grazing of domestic livestock has preceded the practice of intensive agriculture. On a large part of the western region of the United States, raising livestock will probably always be of first importance in agriculture.

Livestock in the West. — Prior to the landing of the Jamestown colonists, a group of sturdy Europeans of unknown extraction is thought to have settled in what is now Mexico and engaged in the grazing of livestock. When this settlement was established is not definitely known.

The following records of livestock landings on this continent are based on the most reliable historical facts available. In 1515 Cortez, the Spanish adventurer, landed sixteen horses near Vera Cruz, on the eastern coast of Mexico. He may also have introduced a few cattle at that time. In 1521 Gregorio Villalobos, Governor-General of New Spain (Mexico), brought a number of young cattle from San Domingo to Mexico. These cattle, like those of later importations, were apparently first landed on some of the West Indies. In 1540 Coronado, the Spanish soldier-leader, took with him from New Spain large numbers of cattle, sheep, and horses on his expedition to the northeast. Thus the year 1540 marks the time when cattle and sheep are first known to have come into the states of the Union. From Mexico, livestock importations were made northward in three directions — along the Pacific Coast, where ranching was extensively developed by the Franciscan Missions to the northeast into Arizona and

New Mexico, and along the Gulf Coast into the plains of Texas. From these foundation herds, the livestock industry in the West progressed rapidly.

Livestock in the East. — In 1545 some Portuguese adventurers are thought to have introduced the first cattle, sheep, and hogs on the eastern coast of this continent. The animals were probably landed on Cape Breton Island, whence they spread to Newfoundland and the nearby mainland. In 1598 the Marquis de la Roche, when landing some French colonists on Sable Island, which lies southeast of Cape Breton Island, found wild cattle and sheep on the islands. About 1611 the "Voyage to Virginia" carried with it cattle, horses, goats, and hogs in goodly numbers. In 1625 Dutch settlers brought many cattle to New Amsterdam (New York). Four years later the Colony of Massachusetts Bay also brought livestock to North America. In 1638 the Swedes and Finns, who settled along the Delaware River, introduced livestock. Following this, importations of livestock were frequent. In 1870 livestock from the eastern states were rapidly marching westward; crossing the gaps of the Rocky Mountains, they merged a few years later with the livestock in the West.

Obstacles to Production. — At first the most serious obstacles to the raising of livestock were the depredations committed by the Indians and by predatory wild animals. As soon as the Indian reservations were established and the Indians fairly well confined to their "private hunting grounds," the stock industry progressed with great rapidity, since almost ideal conditions prevailed over the vast expanse of the western country for the development of cattle and sheep raising.

Between 1885 and 1890, practically all available western range lands became fully stocked; indeed, vast areas were grazed beyond their carrying capacity, and had begun to decline. The herds continued to enlarge, however, until 1893 when both cattle and sheep were lost in astounding numbers by starvation in the Southwest. In the Northwest, shortage of feed due to overgrazing, drought, and severe winter weather occurred as early as 1886. Thus the chief growth and the beginning of the decline

of the livestock industry occurred in but little more than half a century — from about 1840 to 1890. The demand for forage put into use for the first time vast areas which in earlier days had not been considered suitable for grazing domestic livestock.

The Lands First Occupied. — At first the stock industry, like farming, was confined to localities where climatic conditions, particularly during the winter, were especially favorable. Keeping cattle and sheep on the range throughout the year without any attempt at winter feeding, either of hay or concentrates, and conducting the livestock business on a large scale made it possible to rear stock at exceedingly small cost.

When the better yearlong ranges became overcrowded, profits declined sharply. This discouraged expansion, and the turn of the tide was further hastened by severe winters and unusually dry summers which greatly reduced the forage crop. In many localities there also were severe water famines. For example, in 1834 drought made it necessary for the friars to slaughter practically all of the Mission cattle in California. Drought again caused disaster between 1862 and 1864, and the cattle population in California declined sharply. Sheep, on the other hand, were increasing rapidly despite the shortage of forage, and in 1860 they had increased sixfold in California.

In other western states similar changes took place. In Texas, the mother state of the western cattle-range business, so many cattle were raised before the Civil War that the markets of New Orleans and adjacent towns were unable to absorb the annual surplus. Texas cattle were a drug on the market for about a quarter of a century prior to the Civil War, and prices dropped as low as \$1.00 a head. Between 1850 and 1860, hundreds of thousands of cattle were sold merely for the value of their hides.

The Texas Trail Herds. — At the close of the Civil War there was a strong demand for all grades of cattle. A number of alert stockmen ventured upon a new industry, that of driving Texas cattle over the northern ranges to the market. The first attempts were made in 1866, when about 250,000 Texas steers were trailed north with marked success. The entire summer was spent in driving the cattle to their destination, and since they

were herded over the choicest of range they were well-nigh ready for the block in the autumn. This system of marketing, however, was vigorously opposed by stockmen outside of the Texas fever zone, as it was feared that tick-infested southern cattle might seriously menace the entire livestock industry. In spite of this opposition the Texas cattle drovers sent from 300,000 to 600,000 head of cattle north annually, and thus carried on a relatively successful business for many years. The southern cattle sent to the cool northern ranges made bigger seasonal gains and attained better size and more desirable form than could be expected if they were kept in the South, and the cost of grazing in the North was no greater. Thus the northern cattle business for some time consisted largely of buying young southern steers and driving them north where they were prepared for market.

NATIVE GRAZING ANIMALS

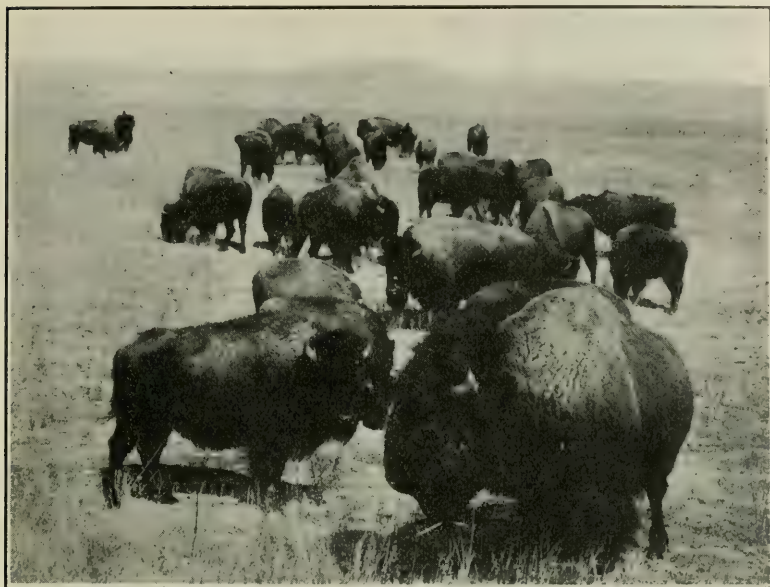
While the stock raisers were gradually gaining dominion over the range, their stock had to compete for forage with the countless native grazing animals, conspicuous among which were the buffalo, wild horses, and elk. That these animals constituted no insignificant factor in the utilization of the forage may be appreciated from their numbers. Gilpin,¹ and others competent to judge, estimated that the number of buffalo, wild horses, and elk in 1873 amounted to not less than 100,000,000. The forage consumed annually by these animals probably greatly exceeded the amount consumed by the cattle and sheep grazed on these ranges today.

Buffalo or Bison. — It is well known that overgrazing has been most instrumental in causing deterioration of the range country. That the buffaloes had something to do with this deterioration is apparent from their immense numbers and possibly from their habits (Fig. 1). The following figures, compiled by C. J. (Buffalo) Jones² are authoritative estimates of the number of these

¹ Gilpin, William, "Mission of the North American People." J. B. Lippincott Co., Phila., p. 72, 1874.

² Inman, Henry, "Buffalo Jones' Forty Years of Adventure." Crane and Company, Topeka, Kan., p. 255, 1899.

animals that roamed the Great Plains and the rate of their slaughter.



(Forest Service.)

FIG. 1. — CHARACTERISTIC GRASS-EATERS OF THE PLAINS IN FRONTIER DAYS.

The buffalo, once so numerous on the ranges, is now represented by about 5000 head on game preserves and National Forests. They are reproducing well.

NUMBER OF BUFFALOES, RATE OF THEIR SLAUGHTER, AND USE MADE OF THEM

Year	Number	Killed	Killed for hides
1864.....	15,000,000	1,000,000	40,000
1869.....	14,000,000	1,600,000	800,000
1871.....	7,500,000	4,000,000	3,200,000
1888.....	150	150	130

In the days of their maximum numbers, these huge, shaggy animals were probably more numerous than the cattle that are maintained on the same ranges today. The buffalo, like the

cow, preferred grasses (especially the well-known buffalograss), but under stress of hunger, which was sometimes his lot while he dominated the Plains, he was known to consume much browse (shrubby) and herbs other than grasses.

The range destruction by the buffaloes was wrought not by close and continued grazing but by the surging and plunging stampedes. In the course of a monstrous stampede, the animals poured over hill and plain like a living cataract, tearing asunder and uprooting much vegetation. The slightest disturbance, the cry of a coyote, the flash of a meteor, the bark of a prairie dog, almost any slight disturbing phenomenon of nature, would stampede the ever-vigilant buffaloes. Usually buffaloes congregated in immense herds and migrated in mass formation; however, as they did not return by the same route, remnant bits of vegetation were more or less normal upon revisitation, although much of the season's growth was destroyed.

The transformation of the forage into domestic beef and mutton instead of into buffalo hides and meat of questionable value for domestic use was an economic measure of unavoidable necessity. Our domestic meat animals, owing to their habits and the ease with which they may be handled, produce infinitely more flesh, and that of superior quality, for the amount of forage consumed.

Wild Horses. — In addition to the native grazing animals of little or no value to the rapidly growing population, there is the wild horse. Because of the peculiar habits of nomadic horses, they are particularly destructive to pasture lands. Opinions vary as to how long our present wild horses have roamed the plains. It is well known, however, that the wild horse of today cannot be identified with the horse of prehistoric ages. The origin of the present wild horse dates back to the expeditions of the Spanish explorer Francisco Vasquez de Coronado, one of Cortez's lieutenants, who in 1541 made various detours into the plains country. During his travels many of his horses were stampeded by the buffalo, escaped the rein and saddle, and formed the basic stock of our sure-footed "cayuse." The Spanish settlement in the Southwest in 1800 was also responsible

for the release of several horses,³ which, owing to the favorable climatic and range conditions, increased rapidly in number. So favorable were conditions that in 1875 no less than 50,000 wild horses were roaming at large in Texas, Colorado, Kansas, and Nebraska — and they were at that time considered practically exterminated in the Southwest. Then, as previously, they were causing serious destruction to the range. This was due largely to their playful romping habit and the long distances they traveled.

With the sharp decline in prices between 1891 and 1895, domesticated horses were allowed their liberty on the range. They deteriorated about as rapidly as they multiplied, and range areas became stocked with horses of little or no commercial value. In Nevada unclaimed horses became so numerous that in 1897 a law was enacted providing for their destruction. The war on these "unbranded wild" animals caused destruction to many valuable branded horses, and the financial loss was keenly felt. Hence this law did not accomplish its aim and was soon modified. There are still thousands of useless wild horses on the native ranges today.

MEAT CONSUMPTION AND PROSPECTIVE SUPPLY

No country, with the exception of India, possesses so many domestic foraging animals as the United States. The numbers of domestic livestock the world over and the numbers in important meat-producing nations are shown in Fig. 2. The data show that the 16 countries that have more than ten million cattle or sheep possess 65 per cent of the world's domestic herbivora. In cattle and sheep production, India, the United States, Australia, Argentina, European Soviet Russia, and Brazil are the leaders, in the order named. In the number of animals to a square mile, Uruguay ranks first, followed by the United Kingdom, Germany, New Zealand, Roumania, Spain, and France. The United States ranks eleventh. When the animals are considered on a

³ Inman, Henry, "Buffalo Jones' Forty Years of Adventure." Crane and Company, Topeka, Kan., p. 168, 1899.

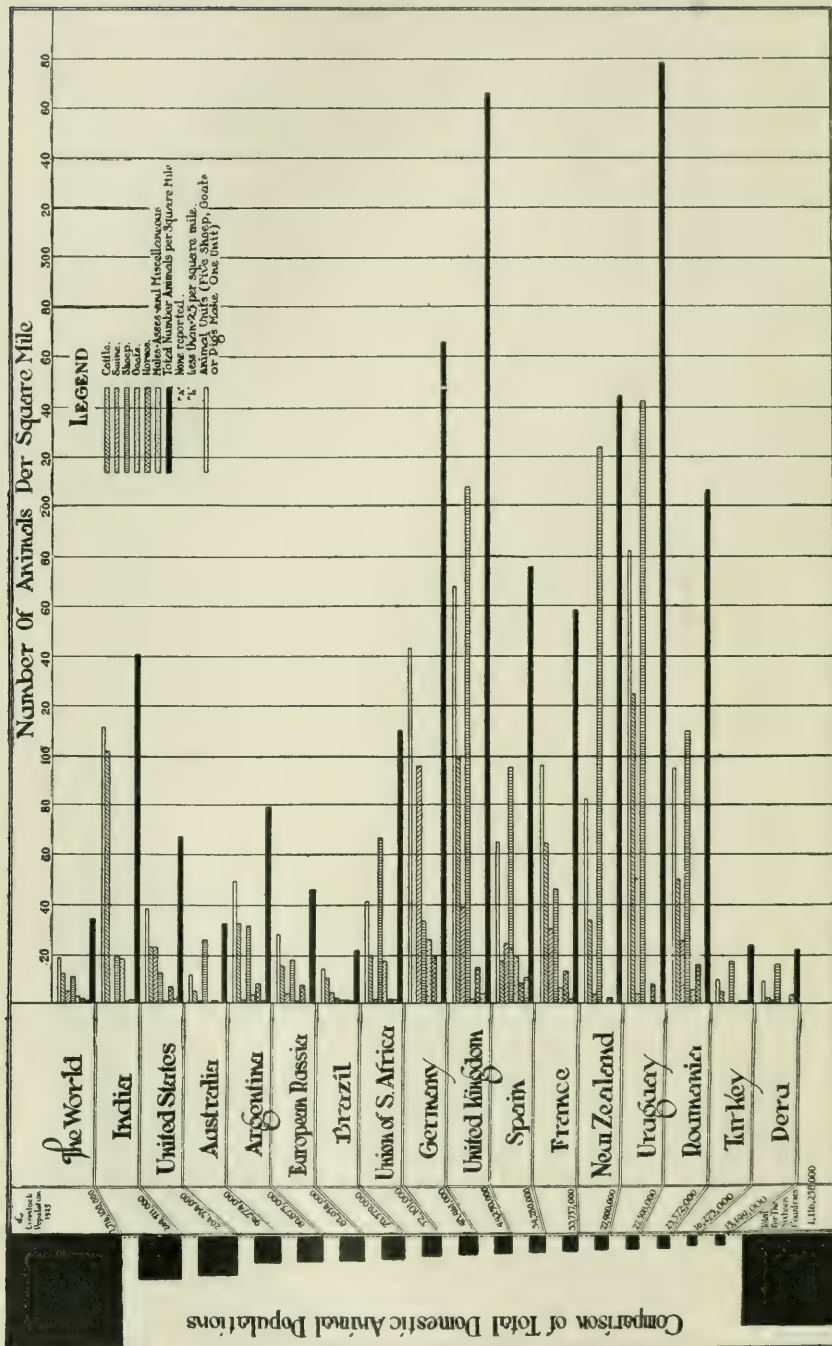


FIG. 2. — COMPARATIVE NUMBERS OF LIVESTOCK OF THE LEADING MEAT-EATING NATIONS OF THE WORLD.

unit basis of forage consumption,⁴ the order is: Uruguay, the United Kingdom, Germany, India, France, and Roumania, the United States again being eleventh.

In 1925 there were, to every 100 people in meat-eating nations, about 30 cattle, 33 sheep, 16 hogs, and 6 horses, whereas in the United States there were, to every 100 people, 57 cattle, 34 sheep, 47 hogs, and 15 horses. In 1925 the average per-capita meat consumption per annum by people in 22 meat-eating countries of the world was approximately 90 pounds,⁵ whereas the average amount of meat consumed by people in the United States was 152 pounds. The heaviest per-capita consumption is in Australia and New Zealand, but the total amount of meat eaten is less in these two countries than in ours. Under pre-war conditions the Englishman ate about 119 pounds, the German 113 pounds, the Frenchman and Belgian 80 pounds, the Russian 50 pounds, and the Spaniard 49 pounds.

The kinds of meats used by the American and by leading European peoples, with the proportions of each, are approximately as follows:

Nationality	Beef	Veal	Pork and lard	Mutton and lamb	Total, pounds
American.....	59	6	81	6	152
Englishman*.....	56	4	33	26	119
German*.....	36	7½	67	2½	113
Frenchman*.....	37	8	26	9	80

* Showalter, W. J., "How the World is Fed." Natl. Geographic Magazine, Vol. 29, No. 1, p. 13, Jan., 1916.

Accordingly, the Frenchman eats about two-thirds as much beef as the American; he eats as much beef as the German but

⁴ Animal units are here expressed as follows: Five sheep, five goats, or five swine are considered the equivalent in forage consumption of one cow, one horse, or one other similar large domestic grazing animal.

⁵ Holmes, Geo. K., "Meat Situation in the United States." U. S. Dept. Agr. Rept. 109, Part 1: 131-133, 1916.

less than half as much pork. The Englishman, on the other hand, eats over ten times more mutton and lamb than the German, and five times more than the American.

The Export Meat Trade. — The European nations produce a great deal of meat, but they are nevertheless obliged to import

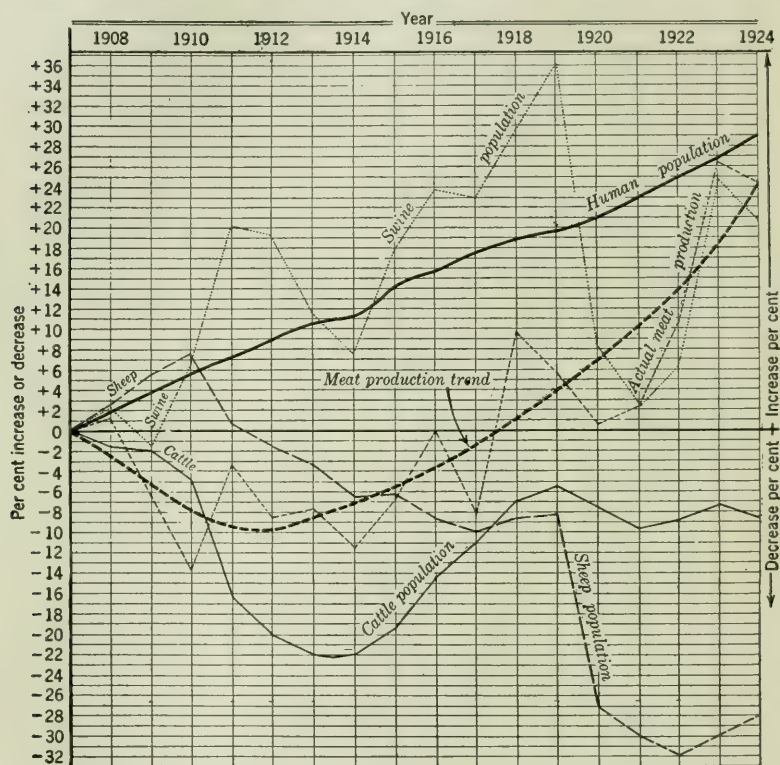


FIG. 3. — COMPARISON OF ANIMAL POPULATION IN THE UNITED STATES, 1907 TO 1924.

large amounts annually. Practically the whole of the meat export trade has for many years been largely maintained by nine countries: Argentina, Australia, Canada, Denmark, Mexico (under normal conditions), New Zealand, the United States, and Uruguay. From 1907 to 1912 meat production in the United States did not keep pace with increase in population (Fig. 3). From 1912 to 1924, however, there was a steady increase in the

amount of meat produced, so that increase in human population and in meat production tend to keep a somewhat similar upward trend. During this period (1912-1924) population increased 19 per cent, whereas meat production increased 34 per cent. All classes of meat animals fluctuated widely in population during the period 1907 to 1924. The cattle population decreased 22 per cent, the decline being steady from 1907 to 1914, then increased 14 per cent from 1914 to 1924. Sheep increased approximately 8 per cent from 1907 to 1910 but decreased 39 per cent from 1910 to 1922. From 1922 to 1924 sheep have increased slightly.

The Magnitude of the Meat Industry. — The distribution of the natural resources of the United States and of its population is such that a large proportion of our meat products must pass from the producer to the packer. Generally, the value of the meat-packing products is greater than the value of all foundry and machine-shop products — the closest rival. An army of more than 100,000 men is employed annually to do the slaughtering and meat packing.

Where do the animals that supply the block, as well as our horses and mules, come from? From all localities, both near the market and remote from it. However, considering the United States as divided by the 100th meridian into an eastern and a western half, the former characterized, in general, by an ample and the latter by a deficient amount of rainfall for the successful production of crops by ordinary farming methods, there is a marked contrast in the number of livestock produced in the two halves. In January, 1925, for example, the number of beef and other cattle, sheep, horses, mules, and swine was as follows:

	Cattle	Sheep	Horses	Mules	Goats	Swine
Eastern U. S.	47,091,000	14,616,000	12,999,000	4,583,000	1,370,000	46,713,000
Western U. S.	17,837,000	24,518,000	4,590,000	828,000	2,089,000	7,521,000
Total	64,928,000	39,134,000	17,589,000	5,411,000	3,459,000	54,234,000

Although the areas of the two portions of the United States, east and west of the 100th meridian, are practically equal, in

1925, 74 per cent of the cattle, 63 per cent of the horses and mules, and 87 per cent of the swine were produced in the eastern half, whereas 63 per cent of the sheep were grown in the western half. These distributions are explained by the highly favorable conditions for livestock production in the West as compared with the growing of field crops and certain other agricultural products. Owing to natural conditions particularly favorable to the rearing of livestock, a few western states are especially conspicuous in the meat-producing industry.

Livestock in the Twelve Chief Range States. — The distribution of livestock in the West varies with the class of stock, the natural conditions, and the grazing capacity of the lands. The comparative numbers of domestic livestock in 1925 are shown in Fig. 4. Texas produces approximately 36.8 per cent of all the cattle, 27 per cent of the horses, and 81.8 per cent of the mules that are produced in the twelve states named. Texas also ranks first in other classes of livestock. California, with 1,994,000 cattle (beef and dairy livestock) and 379,000 horses and mules, ranks second.

In the number of sheep raised in 1925, Texas again leads, California being second, and Wyoming a close third. In 1925, only California, Colorado, Utah, and Texas, of the twelve range states here considered, increased in the sheep population over that of 1915. In the number of goats, in 1920, Texas produced 70 per cent of those raised in the twelve chief range states, New Mexico ranking second, and Arizona third.

Evolution of the Packing House and Refrigeration. — Meat packing, a highly specialized modern industry, has been developed during the present generation. The idea of concentrating butchering near the centers of animal production and shipping the prepared carcasses to the centers of consumption was conceived by a man of unusual foresight — Gustavus Swift. Enormous meat-packing plants have largely replaced the small slaughterhouses formerly common to every community. Today six packing cities handle approximately three-fourths of all the butchering business of this country.

The meat-packing industry was evolved in order to save

freight and it has lessened for the consumer the heaviest freight bills that this nation was paying. Later, a saving practically equal to that of the freight on meats was evolved by using

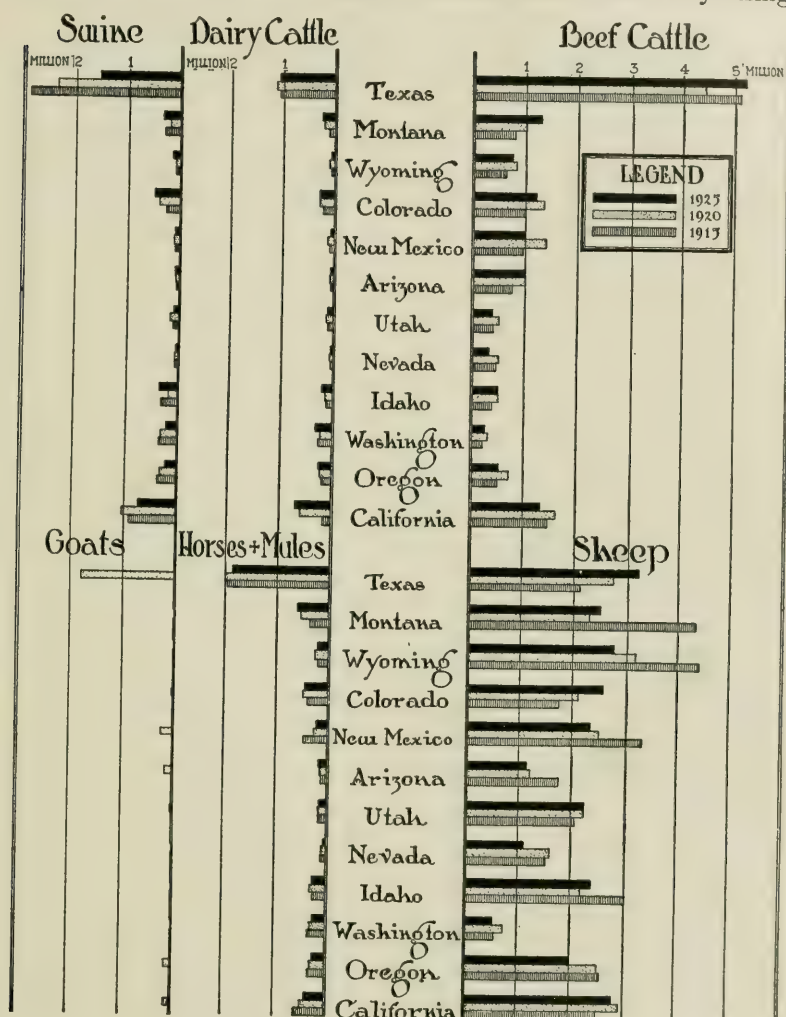


FIG. 4 — LIVESTOCK POPULATION IN THE WESTERN STATES, 1915, AND 1925.

nearly all animal wastages in the manufacture of meat by-products. These savings are probably unsurpassed by those of any other large industry.

The packing industry could not have developed to its present magnitude without the ingenious ice-making machine invented by John Gorrie, a humble citizen of the Florida Everglades. Refrigeration has brought world-wide comfort and pleasure to humanity, making possible to the inhabitants of the tropics the enjoyment of prime corn-fed meats in exchange for their perishable fruits and other cold-storage foods. Cold storage is sure to increase greatly the world-wide transportation of meat and other food. A date less than five decades ago marks the first cargo of meats chilled by machinery instead of by ice. Today refrigerator ships are encountered in all navigable waters.

THE STOCKMAN'S OPPORTUNITY IN MEAT PRODUCTION

In general, stockmen and farmers are not receiving maximum returns from the livestock industry. This may be accounted for largely by poor management methods. The following are some of the ways to effect improvement in management, which will be discussed in the various chapters: Improve and conserve the ranch and pasture resources; reduce the mortality of livestock from diseases and exposure; utilize as far as possible the farm and range roughages; build up and maintain the fertility of the cultivated lands; develop suitable methods of financing livestock enterprises.

In addition to these suggestions, serious consideration should be given the following: Improve the stock by using registered sires that are good individuals; coöperate in production and marketing; secure a higher percentage of offspring; eradicate poisonous plants; destroy predatory and range-destroying animals; have better sanitation; develop more water.

Depletion of Pasture Lands. — The public pasture lands, exclusive of the National Forests, were in 1926 at least 30 per cent below their original carrying capacity.⁶ This condition,

⁶ Carrying capacity of a pasture or range is the number of acres required to support an "animal unit" amply for a given period without permanent injury to the forage crop. In practice an animal unit may consist of a steer, a cow, a cow and her unweaned calf, a ewe, a ewe and her suckling lamb, or some similar individual or pair.

caused chiefly by overgrazing, obtains also, in general, in the private pastures, though there it is less marked. Without State or National Government control of the public-domain lands, the forage which they produce cannot be used to the best advantage, nor can any appreciable increase be expected in their carrying capacity. The most expedient and economic means of revegetating range lands is fully discussed in the text, "Range and Pasture Management."⁷

Proper management of stock and pasture lands is obviously the basis for livestock expansion. In addition to low grazing capacity of vast range areas, the annual death toll of livestock, due to disease, excessive exposure, and improper housing, is an important factor for decreased livestock profits.

Disease and Exposure. — The available meat supply would be greatly increased and the expansion notably more rapid if the more common diseases were better controlled and the heavy losses caused by exposure to inclement weather minimized. Between 1905 and 1924 it is estimated by the Federal Government that from 1,115,000 to 1,444,000 cattle died each year from various diseases, and from 603,000 to 1,427,000 from exposure. In the case of sheep, the losses from disease have been about the same as the cattle losses, but those resulting from exposure have been much greater.

Effective windbreaks and inexpensive open sheds are often determining factors between profit and loss. Ample supplemental feed in winter and suitable shelter will greatly decrease not only losses from exposure but those from disease as well. An animal weakened by disease and exposure cannot reasonably be expected to return a profit unless ample feed is provided to build it up and put it in good condition. The more enterprising stockmen are now protecting themselves against heavy losses by providing such shelter as the conditions may permit and by providing a little supplemental feed.

Waste of Farm and Ranch Feeds. — Frequently the feeding value of the farm and ranch roughages, such as straw and

⁷ Sampson, Arthur W., "Range and Pasture Management." John Wiley and Sons, Inc., N. Y., pp. 40-103, 1923.

similar by-products, is greatly underestimated, and they are only partly used. Enormous quantities of livestock feeds, the money value of which amounts to millions of dollars, are wasted annually or put to only limited use. Failure to utilize the numerous by-products of farm and ranch to the best advantage has increased unnecessarily the cost of meat animals; it has also diminished profits from feeding all classes of livestock, and it has correspondingly decreased the fertility of the soil.

No system of maintaining soil fertility is as economically conducive to crop production as the feeding of livestock. In far too many instances, straw, corn stover, the sorghums (kafir corn, milo maize, etc.), pea-factory refuse, and other roughages are only partly utilized to the best advantage; i.e., for livestock production.

Of the annual straw crop of about 128,000,000 tons, it is estimated that in 1924 about two-thirds was fed or otherwise used in connection with livestock. Like corn stover, the sorghums and similar crops, enormous quantities of straw are either burned — an almost total loss — or scattered over the fields shortly after harvesting, so that much of the fertilizing value is lost through leaching.

The present practice is to export for the use of European feeders vast quantities of cottonseed meal and cake, molasses, corn, and other valuable concentrates. If the roughages that are now largely wasted were used to feed livestock all the valuable concentrates produced in this country could be utilized at home by the American farmer and ranchman. The result would be a notable saving not only in the cost of steaks and chops but also in the cost of maintaining soil fertility.

In many instances the feeding of straw and other available feeds in the winter would insure better utilization of the summer forage crop. If the roughage, which otherwise has little or no money value, is utilized to lessen the cost of wintering, stock may be purchased to advantage in the autumn or winter and used to graze the spring and summer forage.

The economic use of all available feeds is of the utmost importance to American meat producers, as only those producers

who are able to use all palatable feeds will succeed. Continued profitable crop production implies maintaining the soil in a high state of fertility — and this can be done most economically through the handling of livestock.

Unprofitable Acres vs. Diversified Farming. — In regions where chiefly corn, cotton, wheat, and other staple crops are grown, farming is sure to undergo a radical change — the logical course of nature demands it. Rotation in crops is essential.

In many regions the importance of maintaining the soil fertility by means of diversified farming, including livestock raising, has scarcely been recognized. The present-day farmer, like his forefathers, has been content to apply his time and labor in extracting the wealth the Creator placed to his credit in the soil. But finally, when the impoverished fields fail to respond, scientific management becomes imperative to success.

Diversified farming, with plenty of livestock to furnish the fertilizing element (and incidentally to pay off the mortgages), accompanied by the rotation of crops, ultimately will be forced upon the cerealist. Lack of crop rotation has taken the wealth from the soil and the Golden Hoof will have to replace it. Drought-resistant crops can be grown where necessary, so that insurance against shortage of stock feed is practically guaranteed; the silo, a feature of every well-managed farm, provides an ideal means of storage. A larger investment is required where livestock is run in connection with the farm, but, with roughages available, serious difficulty is seldom encountered in obtaining loans with which to purchase the desired livestock.

Financing Livestock Enterprises. — Credit is the basis of the livestock enterprise as it is of other large industries, and appreciation in the value of meat animals has materially increased the monetary necessity of the trade. Despite the high cost of livestock, however, neither the investor nor the lender is assuming greater responsibility than formerly when meat animals were less costly.

The Safest Loan. — The most desirable livestock as security for loans, from the standpoint of the banker, are cattle and sheep in the feed lot. Such animals usually gain in weight and in

intrinsic value from the day the loan is made on them. The feeder may lose in the ultimate transaction, but the market must drop abnormally fast to prevent the daily gain from counterbalancing the actual value of the animal. Stocker or breeding animals are not especially attractive to the financier because they must be handled for a long period, thus involving greater risk of loss of animals and of decline in price. Bankers prefer short-time loans.

Loans on Range and Pasture Animals. — Loans on livestock maintained on range and pasture are frequently discriminated against, partly because the animals are often scattered and thus not constantly under the close observation of their owners, and partly because in times of severe drought or abnormal storms the lender finds it necessary to make frequent inspections. Such inspections are difficult and expensive and decrease the money earnings.

Pasture and range livestock as security for loans have always been unpopular throughout the history of the livestock industry. During the eighties of the last century the livestock loan business was conducted on a bonanza scale. At that period, to be sure, livestock loans were extremely hazardous. In some respects the period was a Golden Era, but there was another side in sharp and gloomy contrast. Fortunes were made and lost on the caprice of the elements and livestock owner and lender were both mere gamblers on Mother Nature. The haystack was almost entirely unknown, and after a moderately bad winter they counted the "dead ones" — indeed in severe seasons labor was saved by enumerating the survivors. Had as much been required then as now to run a given number of cattle or sheep, and had the same reckless method of handling prevailed, uniform failure would doubtless have resulted. During periods of depression the entire capital, not only of individuals but of corporations, was literally wiped out. In the early days expansion was the logical procedure for making easy and quick money, and when disaster did not result from adverse weather it was likely to follow overstocked markets. During periods of depression, cattle and sheep were liquidated at less than was required to

reimburse the loaner, and carriers refused to accept meat animals, regardless of their quality or condition, unless freight charges were prepaid, so problematic was their value at the market centers.

Financial Adjustment. — Now the element of risk has been materially decreased as the practice of supplemental winter feeding has become somewhat general. The accepted practice today is to insist on such winter feeding as is consistent with the pasture resources. In that great cattle-breeding ground — the Panhandle of Texas — practically all contracts require the feeding of cottonseed cake during at least a part of the winter. Accordingly, both cattle and sheep loans are made with little risk. Sheep paper, which for many years was severely discriminated against, has, within the last decade, been established on a high plane of reputability. Plungers and incapables have been eliminated and sheep products have become more stable. Under former conditions the flock took chances with the climate; haystack insurance, especially in the bleak Northwest, is now the rule.

Future Livestock Loans. — Despite the widening of the market for both cattle and sheep securities, the commercial breeder has difficulty in securing loans. Bankers are compelled to keep their assets in liquid condition and their business requires a remittance at frequent intervals, preferably not more than six months apart. The commission man, financing grazing and feeding operations, is in a similar position. However, a herd of cows or a band of ewes is a safe loan proposition, especially if the contract includes the increase and the same business principles are applied as in loaning on any other industry.

Cattle and sheep raisers planning a breeding enterprise necessarily have to figure several years ahead, which makes their papers an investment loan. If the necessary long-time loans could be obtained at reasonable rates of interest, one of the most serious handicaps in the recuperation of the waning meat supply of the nation would be eliminated.

The financing of the livestock industry during the next decade will necessitate the use of more money than in the past and the

loan company system is likely to gain in prominence. However, it must be remembered that every dollar of his own that the producer can put into his business will materially fortify his position. He is then less subject to money market exactions, especially during periods of stringency, and is better able to take advantage of good business opportunities. When one desirous of making a livestock loan is able to meet part of the purchase price he invariably gets preference and a better rate of interest than one with no capital invested.

Future Livestock Production. — Increased care and feeding of livestock, while necessary to modern production, will nevertheless tend to increase the cost of meat and other animal products. Exorbitant meat prices to the consumer, however, can be avoided to a marked degree by the adoption of more carefully planned and executed pasturage and breeding methods by the producer, and by popularizing long loans on livestock papers at reasonable rates of interest to favor the establishment of the breeding herd.

The recognition and enforcement of all the facts favoring livestock production will greatly tend to increase the future meat supply of the nation. With improvement in livestock management generally, it is not improbable that within the next decade or so our export meat trade may exceed the exportations of meat products previously enjoyed.

QUESTIONS

1. When and by whom were cattle and sheep introduced in the far western range states? When was livestock first introduced in the eastern states?
2. Name the two most serious obstacles to the rearing of livestock in the early days of the industry in the West.
3. When did the grazing capacity of the native western range lands begin to decline? Could this deterioration have been avoided?
4. Discuss the natural advantages of the lands in the West that were first utilized for livestock grazing.
5. How did the Civil War affect the development of the livestock industry?
6. (a) Discuss the origin and economic basis of the Texas trail herds.
(b) Why did northern graziers object to the enterprise of the Texas trail herd?

7. (a) In what way did the native grazing animals exert an important influence on the development of the grazing of domestic livestock in the West? (b) When were the bison, or buffalo, most abundant and how did the numbers of buffalo or bison when at their maximum population compare with the numbers of domestic animals grazed on these lands today? Upon what feed did the bison chiefly subsist?

8. What is the date of origin of the first wild range horses and what was their ancestry?

9. Are wild horses a factor on the range today? Discuss the enactment of the Nevada "unbranded" horse law.

10. To what extent are farm and ranch livestock by-products wasted and what relation does this waste bear to soil fertility?

11. What is the history of loans on range livestock? What constitutes a safe livestock loan?

12. Why are loans for the breeding of livestock on the range difficult to negotiate? How does this difficulty affect the expansion of the stock industry?

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CHAPTER II

PRACTICAL METHODS OF IMPROVING DOMESTIC FORAGING ANIMALS

Both scientific and practical knowledge are needed by the breeder who would make the most of his herd. Practical knowledge is necessary to enable him to know his individuals and the things about animals which no book can teach him.

Scientific knowledge he needs to interpret his results and to help him plan intelligently his future operations. The laws of heredity operate in a definite manner and it is necessary for him to know these laws if he expects to achieve success in its fullest measure. There have been many successful breeders who have known naught of the scientific side but undoubtedly the measure of their success would have been much greater if their practical knowledge had been flanked by the scientific fundamentals.

Definite ideals are also needed by the breeder — to work without ideals is like setting sail without a rudder.

Practice of Breeding. — Every animal differs from every other animal, even of the same breed, in respect to its breeding tendencies. What the individual peculiarities are can be learned only by close study on the part of the breeder, and how closely this knowledge is tied up with breeding success is proved by the fact that even an experienced breeder can not obtain for a time as good results with new stock as could its older owner. The man who aims to be a constructive breeder today will do well to study his individuals as closely as did the men who built up the breeds in the early days, for it is as true today as it was then that with knowledge of the breeding tendencies of the individuals comes steady improvement in the herd.

Selection. — Without selection there can be little or no permanent improvement in a herd or flock, for almost all the control over heredity which a breeder possesses lies in selection. Feeding and care may aid in the work, but the basis of improvement

is selection. To be able to make selections wisely necessitates good judging ability on the part of the breeder and this in turn rests on his familiarity with the ideal type of the stock in question and his powers of observation. The successful breeder studies the possibilities and limitations of the breeding animals he owns and also takes into consideration their ancestry before he mates them. Haphazard mating gives mediocre results even when good animals are used, while careful selection tends to make the progeny superior to its parents.

Crossbreeding. — Crossbreeding has been successfully practiced for the production of market stock, but when it has been attempted without careful study it has largely resulted in loss and disappointment to the breeder. Instead of the resulting progeny having the good points of both parents, as is hoped and expected, it is very likely to have the objectionable features of both.

When practiced intelligently, crossbreeding has a distinct place in the breeding world (Fig. 5). Many of the new types



(Forest Service.)

FIG. 5. — THE PROGENY OF CROSSBREEDING.

Lambs produced by breeding fine-wool grade ewes to purebred Shropshire rams. They are an excellent product for the market but they should not be retained for breeding.

of animals have been developed from crossbreeds, the usual practice being to cross two distinct types, and then after individuals of the second generation have been obtained by mating

animals of the first, to fix the type by close breeding and careful selection.

In the production of market animals crossbreeding has a distinct place, as the crossbred is often more vigorous, making a more rapid growth and utilizing feed to better advantage than the purebred. This is especially true in the younger market products. For instance, the crossing of Dorset rams with Merino ewes for raising "hothouse" lambs results in lambs that mature earlier than those from purebreds and are excellent for the early spring market. Crossbreeding in this way for a definite purpose is an economic proceeding, but crossbreds, however valuable for final products, should not be kept in the breeding herd by anyone but the specialist, though the temptation to do so is often strong. The crossbred offspring is highly variable and frequently defective in type, hence no ideal in animal perfection from careful mating may be expected.

Line Breeding. — Line breeding is most favored by practical stockmen. With it there is less likelihood of defectives appearing than with inbreeding. Continued line breeding results in that very desirable characteristic — to a breeder — uniformity of progeny.

The aim in line breeding is to obtain uniformity of type in a herd by securing a high degree of similarity of blood lines in concentrated form. The method used is to mate individuals that belong to the same line of descent but are not more closely related than cousins.

Line breeding is credited with many desirable results. It possesses a large number of the virtues of inbreeding with less of the risk of producing defectives, but it has the drawback that when it is overdone, or when the individuals are not carefully selected, there is danger that the family characteristics will be dissipated.

Inbreeding. — For fixing the type in the early days of the breed, inbreeding is necessary, but there has always been more or less prejudice against the practice. In the hands of the inexperienced or uninformed, it doubtless is attended with many if not all of the evils credited to it; but in its favor is the fact

that it is the method used by most famous breeders to develop the herds that have made them famous.

The success or failure of inbreeding depends on the selections made, and only an experienced breeder — one who has carefully studied his individuals — should undertake the practice, or the results will be disastrous. It is known that where ill results have come from inbreeding they are not so much due to the kinship of blood as to the kinship of defect. Just as the good characters may be concentrated, so also may the poor qualities be multiplied, so strongly in fact as to overcome the benefits derived from the improved characters.

When superior animals are individually adapted to each other and have no common weakness in their lineage their common relationship has proved an advantage in producing superior progeny. Then, too, individuals that are closely related are likely to have the characteristics sought by a breeder and if he mates together those in his herds that have the qualities which he desires to perpetuate, he usually accomplishes his purpose.

Increased prepotency is one of the advantages which come with inbreeding, for progeny whose parents are rather closely related are found to be more prepotent than offspring whose ancestry is quite dissimilar. Inbreeding will not cause new and valuable qualities to appear but it will make the greatest possible use of those already there. According to Wright,¹ "the primary result of inbreeding is the automatic fixation of hereditary factors whether good, bad, or indifferent."

Grading Up. — It is financially impossible for all those who wish better-bred stock to purchase purebreds of both sexes. The alternative is to grade up their present stock by the use of purebred sires. As an offspring carries one-half of the blood of its sire, if this be pure, in four or five generations the progeny is for practical purposes purebred, although not eligible for registration (Fig. 6).

To secure uniformity in a herd or flock, and to obtain the best results from grading, sires of the same breed and preferably of

¹ Wright, Sewell, "Scientific Principles Applied to Breeding." *Breeders' Gazette*, p. 401, Feb. 20, 1919.

the same family should be used, and the females selected for the breeding herd should be the ones that most resemble the females related to the sire.

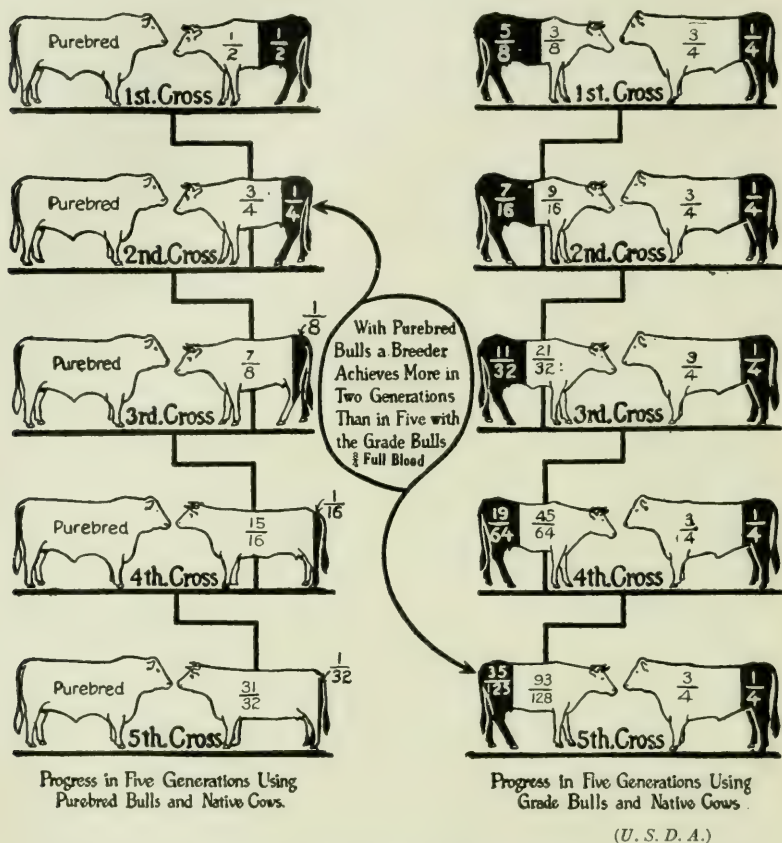


FIG. 6. — PUREBRED SIRES SPEED UP HERD IMPROVEMENT.

Improvement in blood in the herd is remarkably rapid where grade sires are replaced by purebreds.

Age of Breeding Animals. — Breeders hold different opinions as to the age an animal should reach before it is used for breeding purposes, but those who have achieved the best results in the breeding world maintain that the animal should be nearly mature before it has offspring. With grade stock this is seldom done.

Among the evils of very early breeding are weak constitution and a size of the offspring below that of the average of the breed.

The growth of the young dam may be checked somewhat when she calves before she attains her full growth, and this in many instances is never made up.

Bulls are usually purchased when young and the temptation is to use them in service at an early age, particularly if they come from a family the blood of which is keenly desired in the herd. From all viewpoints, however, it is a regrettable practice, for the maximum development of the bull is hindered. Sires with desirable traits are usually retained in service until they are of an advanced age. If there is a physical decline in the bull, there may be a smaller calf crop.

PEDIGREES AND REGISTRATION OF ANIMALS

An animal's pedigree is a record of its ancestry. The value of a pedigree depends on the number of animals enrolled on it that have possessed inherited merit, and the nearer of kin they are the more valuable is their influence. The descendant seven or eight generations removed from a famous ancestor is little or no better than an animal in whose pedigree no famous animal appears, *unless there have been famous animals in the intervening generations*. It is the last four or five generations that have a telling influence over the individuality of an animal.

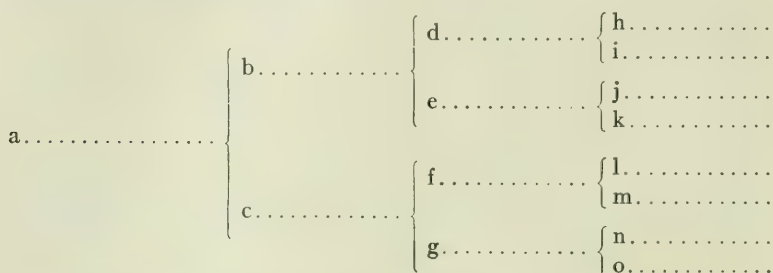
In order that an animal may be registered in an accredited herd book as a purebred, it is necessary that both its parents be registered or be eligible for registry. For registry in some of the newer breeds the requirements are not quite as strict as in the older ones. In some of the new associations animals can be registered if their individual merits meet the requirements, whether their parents or ancestors are registered or not.

Each breed association has its own herd book, and the record of any animal in that breed that is registered can be traced through it. For convenience, however, it is customary to record an animal's pedigree in extended form in the herd record.

The following pedigree of Lespedeza Collynie, taken from the American Shorthorn Herd Book, illustrates the usual manner of recording pedigrees.

<i>No.</i>	<i>Name</i>	<i>Color</i>	<i>Calved</i>
576037 (b)	Lespedeza Collynie	roan	Jan. 5, 1917
<i>Sire</i>		<i>Dam</i>	
Lespedeza Sultan 406929		Sweet Mistletoe v 66, p. 734	
<i>Breeder</i>		<i>Owner</i>	
Lespedeza Farm		Lespedeza Farm	

A method which requires more space but is more valuable in estimating breeding usefulness is known as the tabular form of pedigree. The following is of this type:



When the records of the individual animals are also given in each case it possesses even more value to the breeder.

As the ancestors that an animal has count for so much in its individual performances the necessity for absolute honesty in regard to pedigrees can not be over-emphasized. It is seldom that breeders have been known to misrepresent the pedigree of an animal, but when it is done there is no worse form of dishonesty. It is not a matter of loss alone in the individual animal but loss in the value of all its descendants. In a bull, the loss is almost incalculable. Errors due to carelessness in recording may lead to unreliable records, but conscientious breeders make sure that no such errors occur.

Names have come to possess much significance in the breeding world, and in no other line of business does a good name behind a product stand for more. The person who buys from a well-known and highly esteemed breeder and one with plenty of achievements to his credit, has the assurance that none but good sires for generations are back of his animal, and that there are no inferior females in its line.

Sometimes the name of the animal includes that of the breeder. This "trademark" possesses value in that it tends to assure the buyer, even if he knows little personally concerning the ancestors of the animal, that they are good.

Herd Record. — If breeding operations are to be carried on in an intelligent manner a record of each animal must be kept for the purpose of determining individual worth. With race-horse breeding the objective test is speed; with dairy cattle, daily production and amount of butterfat; with beef cattle, the maximum production of choice meat at the lowest cost; with sheep, the amount of wool and meat produced; and with poultry, the number of eggs. Comparative efficiency tables giving records of world's, country's, or state champions of the same age and at the same season are valuable. The more simple and concise a record is the easier it is to keep and to use.

"Imported" Animals. — In the beginning of breed history in the United States, imported animals formed the nucleus in each breed, for it was in the older countries, England especially, that the breeds originated. Each year since has seen importations brought to America. These imported animals have helped to supply sires for grading and have aided in maintaining the hereditary constitution of some of the breeds, with the result that there have been smaller numbers of inferior animals in this country. Also the imported stock has provided new breeds, and has given America the benefits of European advances in stock raising.

Imported purebred animals for mating purposes can be brought into this country duty free, but some of the older breed associations have fixed a high registration fee on imported individuals to discourage the bringing in of inferior animals. This safeguard has reduced the number of worthless importations. Too often in the past, the word "imported" has been taken as a guarantee of superior excellence, irrespective of the defects of the individual.

Essentials of Good Pedigree. — In itself the pedigree has no merit. As pointed out, its value depends on the individual records of the names inscribed on it. If it carries a good proportion of names of animals that possessed unusual merit and

had characteristics that are transmitted, the logical conclusion is that the pedigree is good and that the animal that carries it, if he also possesses individual worth, will be valuable to the herd. The difficulty is in learning whether the progenitors of the animal had the characteristics sought, and unless this is known a mere pedigree is of little value.

IMPROVING RANGE AND FARM LIVESTOCK

Although the work of improving the livestock breeds in America has been making sure and steady progress in the past, there remains much to be done. On the average ranch and farm in this country the livestock is yet low-grade or scrub, but that this condition is bound to change in future seems assured.

In the past, feeds have been low, and American livestock raisers have not realized to the extent that they do now, when feeds are high, the difference that exists between a scrub and a purebred in forage utilization.

Today the successful stockman and farmer knows he cannot afford to keep scrub stock. The better-bred animal fattens more quickly, is more symmetrical when finished, and hence commands a higher price and is ready for market earlier than the scrub. In addition, a herd with a fair percentage of pure blood possesses uniformity, and a carload which is uniform commands a much better price on the market than one of mixed sizes and types.

When difficulty is experienced in financing the buying of better livestock, in many parts of the country the bankers are advancing loans for the purchase of profitable animals.

In breeding up a herd the two requisites are blood and care. Without good blood the breeder is helpless, but unless care is exercised in selecting the individuals for the matings he will find little or no improvement in resulting generations.

While the influence of the remote ancestors counts, it should not be forgotten that with the careful selection of sire and dam one-half the points of an animal are within the control of the breeder. In the next generation he controls three-fourths of them. This percentage increases until, if the type he has selected

is not too complicated, he can control 90 per cent of the chances on a single given point. Good ancestry will not make a poor individual a good parent. The desirable animal in the breeding herd is one that not only has desirable progenitors but is a good individual as well.

The constructive breeder buys the best animal procurable that has the characteristics he wants in his herd, and each time he buys a still better animal. This is necessary for continued improvement. Another important item in building up a herd is to build on one line of blood. If a sire has produced an improvement, then his successor had better be one of the same family. When the blood lines are not changed with each purchase the improvement is quicker and more certain.

QUESTIONS

1. Discuss the importance of selection in the improvement of the herd.
2. Under what conditions is crossbreeding justifiable?
3. (a) Would you recommend line breeding for use by the average stock grower? If so, why? (b) Inbreeding? Why?
4. (a) What is the object of pedigreeing an animal? (b) How would you procure the pedigree?
5. What are the essentials of a good pedigree?
6. Name and discuss two requisites in breeding up a herd.

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PART TWO

PASTURE HUSBANDRY OF SHEEP AND GOATS

CHAPTER III

LEADING BREEDS OF FINE-WOOLED AND COARSE-WOOLED SHEEP: THEIR ADAPTABILITY TO RANGE AND FARM

In recent years breeds of sheep and their types have received greatly increased attention. It is realized that certain breeds give better returns than others in regions of distinct climate and forage. It is also realized that any breed of merit is superior to nondescript stock. Once a breed is selected the band can soon be improved if rams of a uniformly superior type are selected consistently.

In Europe the different breeds of sheep are confined to rather well-defined areas. In America the different breeds are not as yet strictly confined geographically.

THE MERINO AND ITS TYPES

The Merino and its types, and the Rambouillet, are known as fine-wooled sheep. They are common on western ranges and to a lesser extent in the eastern states. Because of the sharp demand in recent years for both wool and mutton, fine-wooled sheep are undergoing some changes to improve the carcass and increase the length of the wool in order better to approach the dual-purpose type.

"Merino" is a Spanish word applied to the "Governor" of the flock and pastures of a small province. In olden times the appointment to this position was made by the king and the title was that of "Merino Mayor."

The Merino breed originated in Spain. They are small, active animals well suited to the rugged country. The Spanish Merino is the root stock of all the breeds, classes, and types of the Merino in existence today.

For centuries these sheep have been noted for their fine, high-

quality wool, but as producers of mutton they are inferior and their deficiencies in this respect have been improved little in Spain. The breed has a world-wide distribution, chiefly because of its marked adaptability, hardiness, good wool-producing capacity, and the ease with which the animals are handled on the range.

Merinos were introduced into the United States by William Foster in 1793, but they did not then become popular and he had them killed for mutton. Several times in this country the popularity of the breed waned materially.

After the War of 1812, for instance, individuals for which \$1000 or more had been paid could be purchased for \$1 a head. In New England a type was developed which came to be known as the American or Vermont Merino.

The Merino Type. — The American Merino is one of the heaviest and most economic producers of high-quality wool. These sheep have heavy folds over the body, except on the back. On the head the wool is heavy enough to give the appearance of a cap and often obscures the eyes. The ears, the lower part of the nose, and the muzzle are woolless. The skin is a healthy pink. The form of the animal, however, with its long, slender neck, sloping shoulders, narrow chest, and poorly sprung ribs, is admittedly inferior. On this account and because of the difficulty in shearing animals with numerous highly developed folds, the American Merino has been replaced largely by a smoother type, known as the Delaine Merino.

The Delaine Merino differs from the Vermont strain in that it has a larger and smoother body and few or almost no folds. Also, the wool fiber is longer, so that usually it meets the requirements of combing wool. The object of the breeders of the Delaine Merino was to get a combined mutton and wool sheep, and the success of this venture is shown by the popularity of the breed today. The perfection of the breed has resulted in the development of several strains or families of Delaines.

The Improved American Merino. — The Merino in America today is divided into three classes or types, known as A, B, and C. This classification is based upon the mutton qualities, the

folds of the skin, the fineness of the fiber, and certain less conspicuous features. Unfortunately, there is often confusion in the classification of these types, partly because of the lack of agreement among judges as to the distinguishing characteristics of each class, and partly because the characteristics upon which the types are based largely disappear or become exaggerated as the animal develops. The confusion in the classification of the Merino types may be explained from the fact that they come from the same parent stock.

A-Type Merino. — The chief characteristics of the A-type are the extremely heavy folds or wrinkles upon the neck, breast,



FIG. 7. — A-TYPE MERINO RAM.

Note the heavy folds and the covering of wool over body and legs.

middle, and quarters, and the dense covering of wool over the body and legs (Fig. 7).¹ Because of the large surface, due to the folds, upon which a dense covering of wool is produced, the

¹ The author is indebted to the U. S. Department of Agriculture for the use of photographs to illustrate breeds of sheep.

weight of the crude wool is large as compared with the weight of the body. Most of the Vermont Merinos are of the A-type.

Mature rams in good condition weigh about 140 pounds, and the ewes about 100 pounds. Good rams shear about 30 pounds for a full year's growth, and ewes about 20 pounds. The yolk, which should be of a creamy color, constitutes about 70 per cent of the weight of the fleece when the grease and dirt are included. The fleece should be very dense and the length of the fiber should be slightly more than $2\frac{1}{4}$ inches for a full year's growth. The fiber should be soft and pliable, fine, and "crimpy." The wool from this type is graded as fine combing or clothing.

B-Type Merino. — The B-type Merino is a better mutton sheep than the A-type, mature rams in breeding condition weighing from 150 to 175 pounds and ewes from 100 to 120 pounds. In this type the leg of mutton is fuller than in the A-type, the ribs are better sprung, and the shoulders are somewhat less pointed. The B-type has fewer folds on the neck than the A-type, but, as in the latter, folds are present on the breast and flank and about the tail head. However, the covering of wool over the body and legs is not quite equal to that of the A-type, nor is the fleece as dense (Figs. 8 and 9). Good rams shear about 25 pounds when the wool is of twelve months' growth, and ewes about 15 pounds. The fiber should be at least $2\frac{1}{2}$ inches long for a full year's growth, and should be very fine, soft, well crimped, and pliable. The yolk, including grease and dirt, in this type is about 65 per cent of the weight of the fleece. The proportionate weight of the fleece to the body is less in the B-type than it is in the A-type.

C-Type Merino. — To qualify as C-type Merino the animal should have only two or three folds on the neck and breast. Even these should not be very prominent, especially on the back of the neck (Fig. 10). The Delaine is characteristic of this class.

The C-type Merino is blockier, smoother, and more of a mutton sheep than either the A- or B-types. The body is larger, wider, and deeper, the flesh is thicker, and the frame throughout is well covered. Rams in good condition for service should weigh from 175 to 200 pounds, and the ewes from about 120 to 140 pounds. The rams are uniformly horned, although there is a



FIG. 8. — A-TYPE MERINO RAM.

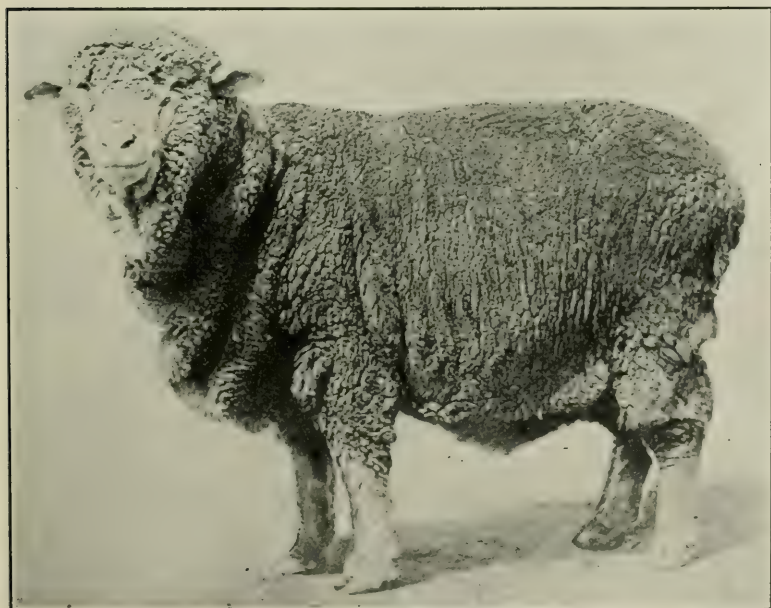


FIG. 9. — B-TYPE MERINO EWE

(41)

hornless strain of the C-type, or Delaine Merino. The fleece in good individuals is carried uniformly over the body, and the face and legs are well covered.



FIG. 10. — C-TYPE MERINO RAM.

The wool of the C-type Merino should exceed 3 inches in length, and it often reaches a length of 4 inches for a twelve months' growth. The unwashed fleece of a ram should weigh about 20 pounds, and that of the ewe about 12 pounds. The fleece is very dense, the fiber soft and pliable and moderately crimped. It is a very superior grease wool.

Advantages of A-, B-, and C-Types. — All types of the American Merino are unusually hardy and prepotent. In most flocks of any appreciable size the three classes are represented. This is considered a distinct advantage, for if at any time the ewes become overly angular and lacking in blockiness, a ram of the C-type may be used to improve the mutton characteristics. On the other hand, if the fleece becomes too open, the use of the A-type ram gives excellent results.

Adaptability to Range and Farm. — While the Merino breed is not so popular as it was fifty years ago, the Merino blood is more prevalent in America today than is that of any other breed. The breed is most popular in the range country of the far West and in the fine-wool section of Ohio. It is also popular in Pennsylvania, West Virginia, and Michigan.

The fact that Merinos are found on both range and farm is evidence of their wide adaptability. On the range the Merino does well when food is scanty and of poor quality; it has adequate protection from inclement weather and produces a good fleece; and the herd bands together well. On the diversified farm where little attention can be given the flock, the Merino gives comparatively good returns.

THE RAMBOUILLET

In 1783 Louis XVI of France bought a large estate near Rambouillet, 40 miles west of Paris. France at this period was raising only a small part of the wool that was used in its factories, and Louis, in an attempt to build up the nation's flocks, asked as a personal favor of the King of Spain that he be allowed to purchase some of the famous Spanish Merinos. His request was granted and a band of Merinos was taken to France and put on the King's estate at Rambouillet. It is largely from this importation that this famous breed has been built up.

The first Rambouillets were brought to America in 1840. From 1850 to 1856, when California was developing rapidly, Rambouillets were shipped into the state. Between 1850 and 1900 the breed attracted little attention, but today superior Rambouillets are found in all parts of the United States. The American breeders have developed Rambouillets which are as good as those in the Continental families and better adapted to American conditions.

The Type. — The Rambouillet of the breeders' ideal is an animal which will produce the maximum of wool and mutton without detriment to the quality of either. In size, the Rambouillets are the largest of the fine-wooled breeds, and are sometimes referred to as "elephant Merinos." Rams weigh from 175

to 225 pounds at maturity and ewes average from 130 to 160 pounds. The Rambouillets are strong in bone and distinctly robust in appearance. Under good conditions of feed and management the rams of this breed will produce from 15 to 25 pounds of wool annually, and the ewes from 10 to 18 pounds. Although the wool of the Rambouillet is not extremely fine in quality or notably even in structure, it uniformly grades what is known in the trade as fine combing and clothing. The staple is from $2\frac{1}{2}$ to 3 inches long at a year's growth.

There has never been created for the Rambouillet a uniform standard with regard to folds in the skin. Breeders have differ-

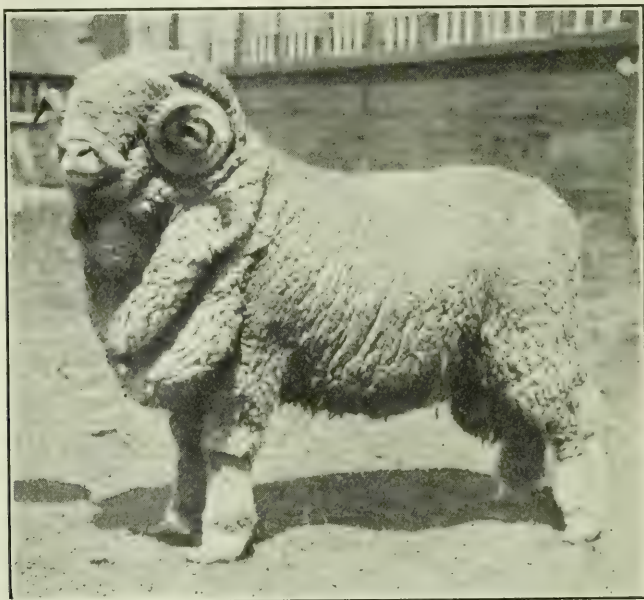


FIG. 11. — RAMBOUILLET RAM, A POPULAR BREED FOR WOOL AND MUTTON ON WESTERN RANGES.

ent ideas on this point. In the West the smooth or plain Rambouillet is the most popular. The head is of good size, with large ears, covered with short wool or fine white hair. The ram usually has large spiral horns but the ewe is hornless. The carcass is long, deep, broad, and heavy, with full, low thigh and flank. The lower leg is short and straight (Fig. 11).

Adaptability to Range and Farm. — A band of Rambouillets herd well on the range and do not scatter too widely. These traits, combined with hardiness, a heavy fleece, improved mutton form, and prepotency, have made the breed the most popular of the fine-wooled sheep in the West today. In addition to these good range qualities, the animals travel easily over long distances to feed and water.

The Rambouillet is well adapted also to the general farm and is found in large numbers in the middle western states. Because of their early-breeding qualities Rambouillet ewes have been used to some extent in the production of winter lambs.

The demand for Rambouillets is generally good and top prices are paid for the best individuals. This is one of the few breeds of American livestock of which appreciable numbers have been exported for breeding purposes. For crossing with grade ewes to develop and improve the ranch flock, the Rambouillet ram has proved his merit. The resulting grade lambs are quick to fatten, are of a good mutton type, and have heavy well crimped fleeces. Also, they may inherit other characteristics of the sire, notably hardiness, longevity, and prolificacy.

THE COTSWOLD

In Great Britain, producers in the early days regarded with favor a large, coarse, late-maturing breed of sheep which produced long, coarse wool. This type gave rise to such important breeds as the Cotswold, the Lincoln, and the Romney Marsh or Kent. These long-wooled sheep are bred primarily for mutton, but they shear a heavy clip of wool and are the largest of the modern breeds of sheep. They are rather loose-framed, rangy in build, with conspicuously broad backs. The fleece is distinctly open or loose, coarse, and long as compared with the fine and middle-wooled breeds. The coarse-wooled breeds are well adapted for grazing on level lands where suitable feed is abundant. The Romney Marsh is noted for adaptability to low-lying lands and surpasses other breeds in this respect.

The Cotswold sheep originated among the hills of Gloucester-

shire,² England. It is a very ancient breed, for as early as 1462 King Edward IV of England permitted Cotswolds to be sent to Spain. The breed of today is, obviously, much improved. For centuries Cotswold sheep have been famous for their wool. The original native Cotswold was tall, rangy, and large. In the latter part of the eighteenth century the old Cotswold breed was improved by the introduction of outside blood, principally Leicester. The first Cotswolds were brought to America in 1832.

The Type. — The back of a Cotswold is broad, like that of a Leicester or a Lincoln, but the body lacks depth. The head is



FIG. 12. — COTSWOLD EWE. BOTH SEXES ARE HORNLESS AND POSSESS A FORELOCK WHICH OFTEN REACHES TO THE NOSTRILS.

distinctive. It is hornless, usually white, with dark nostrils. The forelock, or curls, often reach to the nostrils. The wool is

² These hills are called the Cotswolds. *Cots* was the name given to small shelters in which the sheep in those hills were kept. *Wolds* was the name of the low barrier hills on which they pastured.

coarse, 10 to 12 inches long, and the fleece weighs from 12 to 14 pounds. A mature Cotswold has a fine carriage and is massive in build, often closely approaching the Lincoln in size. Mature Cotswold rams weigh from 250 to 300 pounds, and the ewes from 180 to 200 pounds (Fig. 12). Cotswold sheep make good gains when fed well. Up to twelve months of age, they produce mutton of good quality. At a greater age the fiber of the meat coarsens and the fat is laid on externally.

Adaptability to Range and Farm. — For many years the Cotswold has been popular in the range country for crossbreeding when it is desired to improve the size of the offspring and increase the production of wool. Crossbreeding has been done mostly with the Merino.

On the range the purebred Cotswold is most valuable as a stud animal. On level productive pasture, however, Cotswolds are profitable. Rough range lands are not suitable for the breed. Cotswolds have not given especially good returns on eastern farms, but in the Middle West, particularly in Wisconsin, large flocks are raised.

THE LINCOLN

The Lincoln is reputed to be the heaviest breed of sheep in the world. It originated in Lincolnshire, on the eastern coast of England, bordering the North Sea. It is still the principal breed in this shire, where it is known as the general-utility sheep.

The old-type Lincoln was coarse in conformation and covered with a heavy fleece. As early as 1863 much improvement had been made in the breed by the introduction of Leicester blood, by selection, and by improved feeding methods. In New Zealand, Australia, and the South American states, the crossing of Lincolns with Merinos has given good results. The first of the improved Lincolns were brought to America in 1825.

The Type. — The Lincoln ram weighs from 275 to 350 pounds, and the ewes from 200 to 225 pounds. Their backs are broad and level, and when fat the Lincoln is square and massive (Fig. 13). The mutton is seldom equal to that of a good Down-breed carcass. The fleece is pure white, and 12 to 14 inches long for

a year's growth. A ram's fleece will weigh 25 to 30 pounds, and the ewe's fleece often weighs from 14 to 16 pounds. The wool is bright and lustrous and hangs in large curls, but is of coarse quality. As a breeder, the Lincoln is not in the first rank. The ewes are only fairly prolific, but they are good mothers and usually have milk enough to raise a thrifty lamb.



FIG. 13. — LINCOLN RAM, A GENERAL UTILITY SHEEP.

Adaptability to Range and Farm. — The Lincolns are not so well adapted to the rugged western ranges of this country as they are to the central and eastern areas. Moreover, they are not nearly so popular in America as in their native haunts in England. In Canada the breed is rather well liked. The practice of crossbreeding the Lincoln ram with Merino ewes is popular in the West and seems to be increasing, notably in Oregon, Idaho, and Montana. The crossbred lambs mature early and command a good price. Crossbred Lincolns are hardier,

more rugged, and thrive better on pastures in the western range country than do the purebred Lincolns. Level pastures in arable sections are better suited to the rearing of purebred Lincolns, as they are not good rustlers. The herding characteristics of Lincoln sheep are highly unsatisfactory.

ROMNEY MARSH OR KENT

The county of Kent, which includes the area known as Romney Marsh, is located in southeastern England. The marsh lies practically at sea level; the soil is an alluvial clay, and the climate is moist. Sheep have been kept on this marsh for many centuries. The early Romney Marsh, like most of the native breeds, had coarse wool and was of poor form, but possessed a hardy constitution. The breed is exceedingly well adapted to wet districts, being remarkably free from foot rot and liver fluke, probably because it has built up an active resistance to these diseases.

Romney Marsh sheep appear to be especially well adapted to certain districts of New Zealand and Australia and the breed is gaining popularity on the west coast of the United States.

The Type. — The Romney Marsh is of medium size among the long-wooled breeds, mature rams averaging in weight about 240 pounds and ewes from 160 to 180 pounds. The head of a purebred Romney is hornless, white, and usually has little wool over the face. The individuals are hardy, as would be expected from the fact that they do well on marshes in winter. The feet are usually black, and in Australia black feet are preferred, as white feet are thought by some breeders to indicate a weak constitution. New Zealand breeders attach considerable importance to black feet and endeavor to breed them black. The fleece is thick, compact, and of a long staple, but it does not have the ringlets or the extreme length and evenness which characterize other coarse wools. Rams' fleeces weigh from 16 to 20 pounds, whereas ewes shear from 12 to 16 pounds in twelve months. The ewes are of average fecundity but the lambs are said to be larger at birth than those of any other breed (Fig. 14).

The Romney Marsh crosses well with the Merino. Such a cross is popular in Australia.

Adaptability to Range and Farm. — Romney Marsh sheep are splendid grazers, attaining excellent condition with little or no grain. As stated, the breed possesses a remarkable immunity to diseases prevalent on lowlands. Romney mutton is reported to be superior to that of other coarse-wooled sheep, but it is probably not as good as that of the medium-wooled breeds.

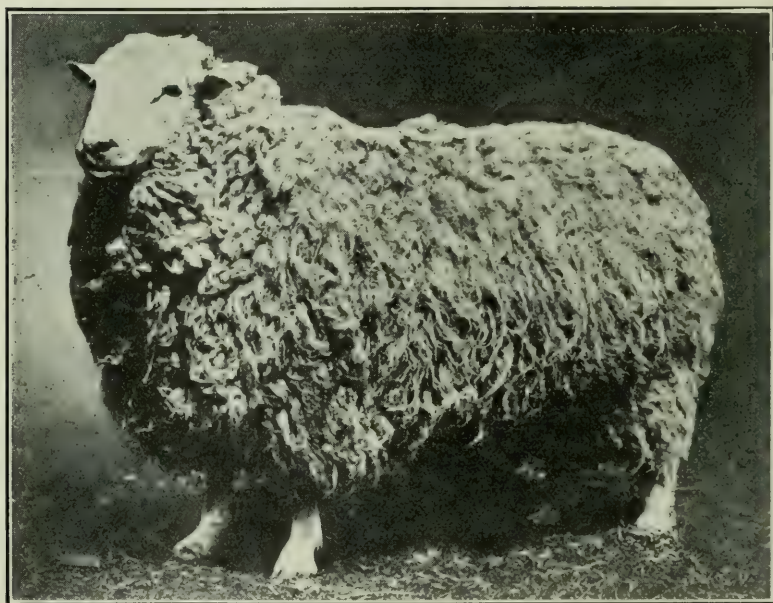


FIG. 14. — ROMNEY MARSH RAM, A HARDY ANIMAL, ESPECIALLY ON POORLY DRAINED LANDS.

Romneys are found throughout the United States and they are replacing the Cotswold and the Lincoln to some extent on the Pacific Coast. Certain characteristics of the breed, such as hardiness, good grazing and rustling qualities, and large lambs, are features which are favored by western sheepmen. Although they may never become a popular range sheep as they lack the herding instinct, they are finding special favor for crossbreeding with Merino ewes in some sections of the West. The crossbred

sheep combine wool and mutton satisfactorily; they are heavy shearers, hardy, good mothers, and herd reasonably well.

THE ROMELDALE

The Romeldale breed has been developed by A. T. Spencer of Woodland, California. Most breeds have originated from a single family by having an ideal firmly fixed in mind, and by attaining this ideal through careful selection and mating. The Romeldale breed, on the other hand, has been procured by cross-breding the Romney Marsh with the Rambouillet and subsequently selecting and mating the resulting cross to establish a type combining the most desirable characteristics.

The Romeldale was developed with a view to producing a sheep better suited to marshy lands and for the pasturing of alfalfa and other heavy forage crops. High mutton quality combined with a heavy fleece of good market demand were the main points sought. The Romney Marsh rams of the most select Australian and New Zealand strains were used with superior Rambouillet ewes. Mr. Spencer states:

"I selected a particular type of these rams and mated them with a superior type and fleece of Rambouillet ewe, the chief object being to get a blend of the wool of these breeds, carried uniformly over the entire animal. The combination of blood concerned offered a good possibility of establishing a high one-half blood long staple fleece. Yearlings from these cross-bred ewes were carefully selected when in full fleece and earmarked as to type and grade of wool carried, particular attention being given to the fleece. After three years of this kind of breeding individuals were selected from a flock of 800 ewes on a basis of body conformation. These selections were made with sires of particular breeding, selecting for fleece and conformation and for a low, heavy bone type. This process of breeding has been continued until now we have the eleventh generation. Each generation has proven more uniform in type and quality of wool than the previous one. The animals are very prepotent and the lambs are early maturing. The 1100 head of ewes are shearing

over $11\frac{1}{2}$ pounds of wool per year in two clips. The wool has an average shrinkage of 46 per cent."

With high prices of lamb and wool there is need for sheep of the Romeldale type. The breed has given an unusually good account of itself where tried under farm and range conditions in California and Nevada. The Romeldale herds well and makes excellent use of natural range grasses.

QUESTIONS

1. Distinguish between fine-wooled breeds of sheep and coarse, or long-wooled breeds.

2. What is the native home of the Merino? In what essential respects does the original Merino differ from the Delaine Merino? Distinguish between the Delaine Merino and the Vermont Merino.

3. Compare the A-, B-, and C-types of American Merinos. According to some breeders, what is the main justification for the maintenance of the A-type Merino at this time? To what extent is Merino blood found in the United States at the present time? Which is the most popular type of Merino for mutton and wool?

4. Discuss the adaptability of the Merino to range and farm. Trace the historical development of the Rambouillet breed. Are Rambouillets popular in the United States at the present time? If so, why? Where? Distinguish between the Rambouillet and the A-type Merino. Are Rambouillets adapted to the range? If so, why?

5. Name the three leading American breeds of long-wooled sheep. Did these different long-wooled breeds originate from the same or from different stock? For what purpose are the long-wools mainly bred? Are the long-wooled sheep of small, medium, or large size?

6. Describe the type of a representative long-wooled sheep, and show how it differs from a typical fine-wooled breed. To what type of land are the long-wools best suited?

7. Distinguish between the Cotswold and the Lincoln. To what extent are Cotswolds used on the range in the far West and with what success?

8. What effect has Leicester blood had on the perfection achieved in the Lincoln breed?

9. Are the Lincolns and Cotswolds as well adapted to low-lying lands as the Romney Marsh?

10. Define the type of the Romney Marsh. Is the Romney Marsh quite as well adapted to rugged mountain range lands as to the more level farm pastures? Does this breed give as good results on low pasture lands as the Rambouillet?

NOTE. — The bibliography for this chapter is placed at the end of Chapter IV (page 68).

CHAPTER IV

LEADING BREEDS OF MEDIUM-WOOLED SHEEP: THEIR ADAPTABILITY TO RANGE AND FARM

All of the medium-wooled sheep, with the exception of the Tunis and Corriedale breeds, were developed in Great Britain. Southern England, in which most of the medium-wooled sheep were developed, is a country of hills or "downs." The medium-wooled breeds came into evidence during Bakewell's time, and originated from a relatively small strain of sheep. They have been bred primarily for mutton, with special emphasis upon the characteristics which made them well suited to the nature of the particular grazing lands and climatic conditions, as well as to the market demands, of the regions in which they were developed.

The face and leg color of all the "down" breeds is brown or black or some shade thereof. As the name "middle" or "medium-wooled" sheep implies, the fleece occupies an intermediate position between the length and coarseness of the long-wooled breeds and the extreme fineness and density of the fine-wooled breeds. The most popular breeds of medium-wooled sheep in the United States are the Southdown, Shropshire, Hampshire, Oxford Down or Oxford, Suffolk Down, Cheviot, and Dorset Horn. The Tunis and the Corriedale are regarded highly in some localities.

THE SOUTHDOWN

The Southdown is the oldest breed of sheep in existence in England. It is named for the chalky "downs" of Sussex County, where the climate is mild and the forage well suited to sheep raising.

The native sheep of Sussex, the progenitors of the Southdowns, were small and ill-shaped, with narrow bodies, sharp broad backs, and long thin necks. Their hind quarters, however, were thick and well developed, and the fleece, while short and thin, was of

good quality. The face and legs of the Sussex were dark brown in color. The improvements made in the present-day Southdown breed have been accomplished largely by selection. This has resulted in a much improved mutton carcass, a shorter neck, a fleece of better quality, and animals of stronger constitution.

The first Southdowns are said to have been brought to America in 1803. They are now well distributed throughout the middle western and eastern states but are not common in the West.

The Type. — The modern Southdown is the smallest of the medium-wooled class. The best specimens possess an ideal



FIG. 15. — SOUTHDOWN RAM, NOTED FOR SYMMETRY AND QUALITY OF MUTTON.

mutton form, being refined and symmetrical, and there is no breed of sheep with a better combination of quality and beauty. The body is rotund, rather than rectangular, and possesses a heavy and even cover of firm flesh. The neck is short and thick and the legs are short and set wide apart. The breed is hornless (Fig. 15). Rams in prime condition weigh about 200 pounds, and ewes about 140 pounds. The Southdown mutton is famous

for its full-grained and juicy lean meat and its white, sweet fat. When prime, Southdown mutton is excellent. The fleece, which is short, close, fairly dense, and of fine quality, weighs from 5 to 7 pounds unwashed. Purebred Southdown rams are used extensively and with marked success for crossbreeding, the lambs invariably having the Southdown quality of mutton, as well as the brown or gray face.

Adaptability to Range and Farm. — The Southdowns have a country-wide distribution in America, but they are most popular in the South Atlantic States. As feeders, Southdown lambs rank very high. Large numbers of Southdowns are found in the Middle West and the North, notably in New York State. In the spring-lamb region of Kentucky and Tennessee, Southdown rams are used extensively. As the individuals are relatively small and the fleece comparatively light, the breed is not popular on the ranges of the far West.

THE SHROPSHIRE

The Shropshire breed originated in the counties of Shropshire and Stafford, England. In the beginning the breed contained mixed blood lines, but there are no authentic records to show just what breeds went into its development. It is one of the older breeds, but it did not have the distinction of being a recognized breed until 1859. From England the Shropshires have spread to nearly every other country that produces superior sheep.

The first Shropshires in America were brought to Virginia in 1855. By about 1880 the breed was well distributed in all the sheep-producing states, and today in many states Shropshire sheep outnumber all other breeds. In the West the Shropshire ram is used for crossing with marked success, especially with fine-wooled range ewes and in the eastern and central United States sheep growers like the breed because it possesses a profitable combination of mutton and wool.

The Type. — The Shropshire is larger than the Southdown, which it resembles. The average weight of the rams is about 225 pounds, and typical ewes weigh from 150 to 160 pounds. The body, which is smooth, compact, and square, is set on short,

neat legs. The breast projects and in a good specimen the thighs are full. The neck is arched and the head held high and proudly. Width between the eyes and ears characterizes the Shropshire



FIG. 16. — SHROPSHIRE RAM.

head, which is hornless. The face, ears, and legs are usually a dark brown or a brown-black. The Shropshire fleece is heavy, fairly long, fine, and of good quality. The ram's fleece averages 12 to 14 pounds, and the ewe's from 7 to 9 pounds (Fig. 16).

No widely distributed breed surpasses the Shropshire in prolificacy. Under farm conditions a lambing of 150 per cent is not unusual from this breed. The lambs are strong at birth, and single lambs average from 8 to 10 pounds. The ewes are excellent mothers and raise thrifty, early-maturing lambs.

As a mutton sheep the breed is in the first rank, for the flesh is of superior quality, fine-grained, and firm, with both lean and fat of a desirable flavor. The Shropshire matures about as early as any other breed except the Southdown.

Adaptability to Range and Farm. — The rustling ability of the Shropshire on hilly land and sparse pasturage is not quite as good as that of the Merino, the Rambouillet, or the Cheviot. Shropshires are essentially farm-pasture sheep and do well in the Corn Belt where they are most numerous. In many parts of the West, however, Shropshire rams are bred to fine-wooled ewes with highly satisfactory results. Ewes and wethers with a preponderance of Shropshire blood are extensive travelers and are inclined to scatter widely on the range. For this reason it is important that, for handling on the open range, ewes with fine-wooled blood be maintained because they herd well. Purebred or high-grade Shropshires must be kept on pastures of high grazing capacity for good returns. As an economical feeder, a comparatively heavy shearer, a provident mother, and a prolific breeder, the Shropshire ranks high.

THE HAMPSHIRE

The Hampshire, or Hampshire Down, breed originated in the county of Hampshire in south-central England. The climate in this part of the island is temperate and moderate yearlong. The breed was developed by crossing the native sheep of Hampshire and Wiltshire, later inbreeding to establish the Hampshire type. Large flocks of Hampshires are still found in the southern English counties and large numbers have been exported to all parts of the world. The first Hampshires are reported to have been brought to America in 1855. About 1880 the interest in the breed increased and large numbers were imported.

The Type. — The Hampshire is exceeded in size only by the Oxford Down, Lincoln, and Cotswold. Rams at maturity average in weight about 225 to 250 pounds, and ewes weigh 160 to 180 pounds. The typical Hampshire has a straight back, a wide and straight loin, and a deep thigh, although often lacking fullness of twist. The face is almost black, wide between the eyes, and the rams usually have a slightly curved or Roman nose. The large ears tend to drop or extend nearly at right angles, and the neck is rather long. The legs are black or brown and free

from wool. The breed is hornless. Although the Hampshire shears heavier than the Southdown, the fleece is not very heavy. The wool is of a medium quality but black fibers are found about the neck and shoulder, which is objectionable from the viewpoint of the manufacturer (Fig. 17). In the percentage of lambs produced, in mothering their lambs, and in milking qualities, the Hampshire ewes have a good reputation.

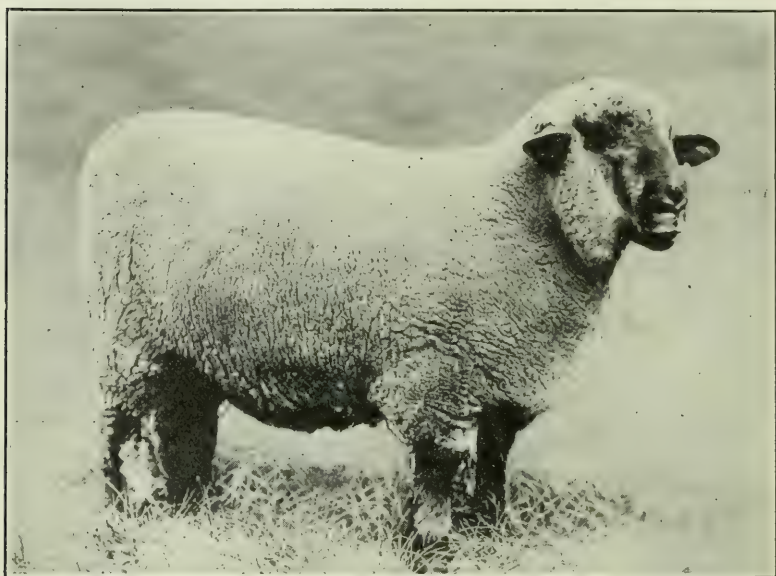


FIG. 17. — HAMPSHIRE RAM, AN EXCELLENT MUTTON SHEEP, WITH A FAIRLY HEAVY FLEECE.

As a mutton sheep the Hampshire is one of the favorites in the English market. Hampshire lambs mature earlier and are of a heavier weight than those of almost any other breed. Their rapid growth is due to their splendid constitution which enables them to eat and assimilate great quantities of feed. The lambs usually gain about a pound a day from the time they are born until they are marketed. Possibly the strongest point of the Hampshire is the ability to transmit its characteristics to the offspring. No matter what breed is crossed with the Hampshire,

the black face, characteristic of the breed, is always stamped on the offspring.

Adaptability to Range and Farm. — The purebred Hampshire is not adapted to very rugged or to scanty pastures. Also the lambs produced by crossing Hampshire rams and range ewes require good feed at all times for the best results. In Idaho, California, and Montana, crossbred Hampshires are among the most popular market lambs. Many parts of the West as well are adapted to the raising of lambs which are marketed at weaning time. For this purpose, the Hampshires have won a permanent place.

Purebred Hampshires do best on smooth, level pasture. Ewes with a predominance of Hampshire blood are not suited to the range, for they do not herd well; and on brushy areas their wool is pulled out badly.

THE OXFORD DOWN

The breeds of sheep that formerly predominated in Oxford County, in south-central England, were Hampshires and Cotswolds. About 1833 several progressive Oxfordshire farmers decided to develop a new breed. In this work Hampshire rams were crossed on Cotswold ewes and occasionally some Southdown blood was introduced. The ideal sought was a sheep which would be well suited to the light farm land, with a good mutton carcass and a heavier fleece than the black-faced ewes carried at that time. A breed of the type desired was finally developed and given the name of "Oxford Down" or merely "Oxford."

The first Oxford Downs were brought to America in 1846. The principal Oxford Down purebred centers in this country are New York, Ohio, Michigan, Wisconsin, Illinois, and Iowa. In the West the rams are used in some sections for crossing purposes.

The Type. — The Oxford Down in general appearance closely resembles the Shropshire, but it is the heaviest of the Down breeds and has the largest frame. Rams in good flesh weigh 300 pounds or more, and the ewes weigh from 180 to 250 pounds. The breed is particularly typified by a high, graceful carriage of

the head. Although the hornless head is rather large, it presents refinement. The ears are smaller and the face and eyes are less prominent than those of the Hampshire. The face, ears, and legs are brown. The contour of the body is rectangular. The wool grows down a little farther on the face of an Oxford Down than on a Hampshire, and on the forehead it forms a topknot.



FIG. 18. — OXFORD RAM, A WIDELY DISTRIBUTED SHEEP IN THE UNITED STATES.

The fleece from the Oxford Down is heavy, and the staple, although not especially dense, is 3 to 4 inches in length. Ten to 12 pounds is the average weight for the unwashed Oxford fleeces (Fig. 18).

The ewes are excellent milkers, good breeders, and fairly prolific. The lambs are large, often weighing 12 pounds or more at birth. Although the lambs grow rapidly, they do not arrive

at a prime market condition so soon as the Hampshire. Oxford Down rams bred to Merino ewes have proved highly satisfactory. Indeed, with any breed where large lambs are desired, the Oxford Down ram has proved meritorious.

Adaptability to Range and Farm. — The Oxford Downs are widely distributed in the United States and in other sheep-producing countries. They are best adapted to farm lands as they make good gains over long periods because of their size. Their mutton is always in demand as it is of excellent grain, with fat and lean well intermixed. Although the Oxford is gaining in popularity west of the Missouri, it is not suitable for the short-grass range country or for rugged mountain lands; and except for occasional crossing purposes, this breed is not used extensively in the far West range region.

THE SUFFOLK DOWN

The heath sheep that ranged the English counties of Norfolk and Suffolk, along the North Sea, are the foundation stock of the Suffolk Down breed. The long, slender bodies and legs, low shoulders, and sharp withers give this breed a lanky and unprepossessing appearance. The improved type, however, is a good mutton form and somewhat resembles the Hampshire except that its head is bare. As a distinct breed the Suffolk is comparatively new. The Suffolks were first imported to this country in 1888.

The Type. — The Suffolk Down is large and active, the rams weighing from 200 to 250 pounds, and the ewes from 150 to 200 pounds. Although they are inclined to ranginess, the choicest meat cuts are well developed, and when in prime condition the carcass is plump and smooth. Jet-black heads and legs characterize the individuals of this breed. There is no wool on the face, or upon the legs from the knees and hocks down. The mutton is of excellent quality, and although the animals are upstanding in appearance, they dress out to good advantage. The most objectionable feature about the Suffolk Down is the rather light fleece and the fact that it grades low because it is intermixed with black and gray fibers (Fig. 19).



FIG. 19. — SUFFOLK EWE, A LARGE, ACTIVE SHEEP, BUT OF LIGHT SHEARING.

Adaptability to Range and Farm. — In about half of the states of this country purebred Suffolk Downs are found, but as yet the breed does not have a firm place. As feeders they are satisfactory. If the lanky appearance could be overcome and the weight of the fleece increased somewhat, the breed would probably gain greatly in popularity. The fecundity of the Suffolk Down is high.

THE CHEVIOT

The modern Cheviot is descended from the native sheep that roamed the Cheviot hills which lie in the borderland between Scotland and England. The climate is harsh the year round, the winters are cold, and heavy snow is not uncommon.

Black-faced Highland, Leicester, and Merino sheep were crossed with the Cheviots in earlier days, but the influence of these breeds was not pronounced. The improvements in the breed have been wrought by selection. The first Cheviots were introduced into the United States in 1838, prior to which im-

portations had been made into Canada. Other importations followed, but not until 1883 did the number of Cheviots in this country increase perceptibly.

The Type. — The Cheviot is small; the rams weigh from 175 to 200 pounds, and the ewes about 140 pounds. The mutton is of good quality. The fleece, although light in weight, is very

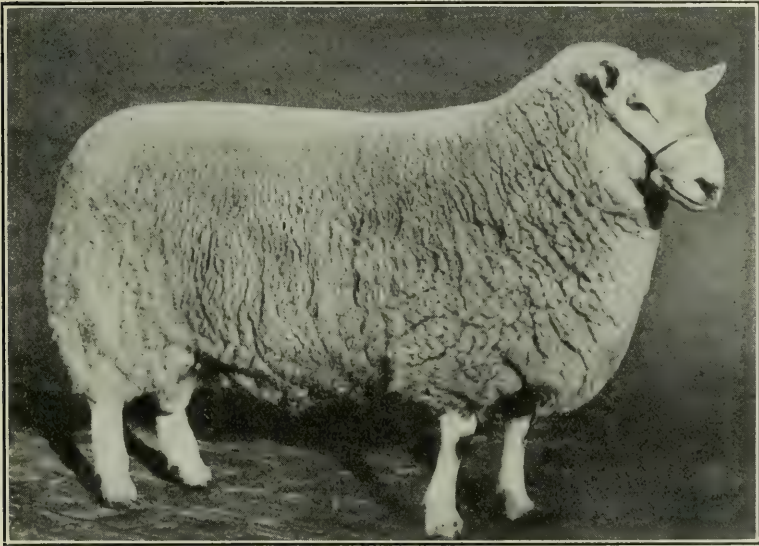


FIG. 20. — CHEVIOT RAM, RECOGNIZED BY THE ALERT APPEARANCE AND THE WHITE, SHORT HAIR ON FACE AND TOP OF HEAD.

white and commands a good price. The head is hornless; the face and top of the head are covered with short, white hair. The eyes are prominent and the ears erect, giving the Cheviot a characteristic alert appearance. The lips and nostrils in a typical Cheviot are black. The fleece is of medium grade and medium length, usually comparatively free from dirt and grease, and therefore light in weight. The wool comes to the knees only and it stops on the neck just behind the ears (Fig. 20)

Cheviot ewes are prolific breeders, a large ratio of twins being dropped in every flock. They are good milkers and good mothers. Cheviots have not been used extensively for cross-

breeding in this country, but they are popular for that purpose in Scotland.

Adaptability to Range and Farm. — Few Cheviots are owned in the West, although as a breed they possess hardiness and are good rustlers on the range. As a pasture sheep in the Old World, the breed is unsurpassed. On its native heath, even when the ground is covered with snow for a considerable period, the Cheviot rustles its living. Although attempts have been made to popularize the breed as range sheep, they have not succeeded, chiefly because Cheviots do not herd well. Each individual is inclined to go by himself. In the farming districts in this country, especially in New York and Kentucky, large numbers are kept. If their tendency to scatter could be overcome, and the weight of the fleece increased, the Cheviot would gain greatly in popularity on the range.

THE DORSET HORN

The Dorset Horn, known also as Dorset and as English Somerset, was developed from sheep that were native to the counties of Dorset and Somerset, in southern England. These sheep were small and coarse, with light fore quarters but well developed thighs. About the middle of the nineteenth century, marked improvement was effected in this breed by selection, although they do not yet possess all of the qualities desired. Most of the Dorset Horn flocks are found in England, Canada, and the United States. The first importations into the United States were in the year 1885.

The Type. — The Dorset is the only horned breed in England that possesses a white face and legs. The horns are present in both sexes. As a breed the Dorset Horn is hardy and is a good feeder on pasture or fodder crops. The ewes breed earlier than any other improved mutton breed and they have a large proportion of twins. The breed is popular where lambs are grown for the early market. No other breed of mutton sheep exceeds the Dorset in prolificacy. Mature rams weigh about 225 pounds, and ewes around 165 pounds. The fleece lacks weight, the unwashed fleece averaging about 6 pounds in a ewe band, but the

wool is of excellent quality. The Dorset Horn does not possess quite as ideal a mutton carcass as the best of the medium-wooled breeds in this respect, since the neck and body are sometimes inclined to be rangy. The head has a short foretop of wool, and the wool on the body extends as far as the knees (Fig. 21).

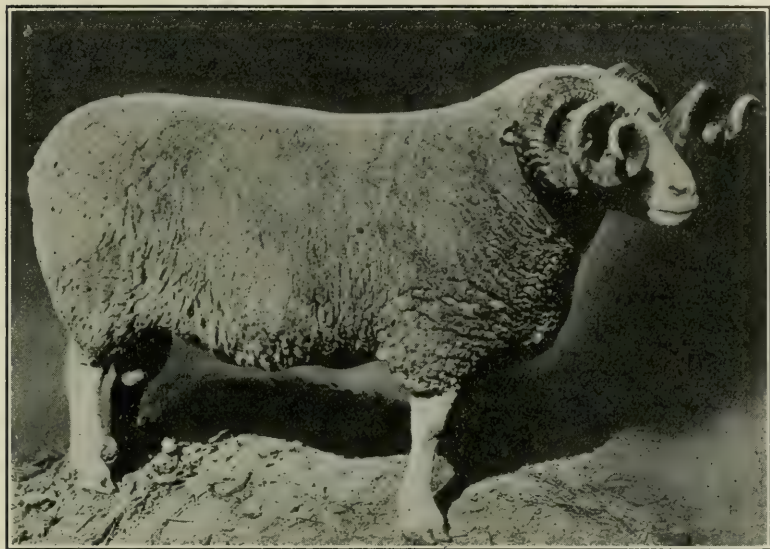


FIG. 21. — DORSET HORN, POPULAR IN THE EASTERN AND SOUTHERN STATES.

Adaptability to Range and Farm. — Though the Dorset Horn is found today in three-fourths of the states of this country, the largest numbers are found in the eastern part of the United States. Where early lambs are grown under farm conditions, the Dorset gives very good returns. West of the Mississippi few Dorsets are raised, as the wethers and ewes are thought not to possess the finish that is characteristic of the lambs; and the fleece is not as heavy as the western sheep grower demands. The stronghold of the Dorset Horn is still in its native districts of Dorset, Somerset, and Devon in England.

THE TUNIS

The Tunis is an Asiatic sheep and is said to have roamed the hills of Tunis and parts of Algeria, in northern Africa, prior to the Christian era. These sheep are sometimes called "fat-tails," but other breeds also possess the fleshy tail character.

The history of the Tunis sheep in America dates from the year 1799. A short time later, flocks were established in many southern states where they met with great favor and increased in number until the Civil War, when they were practically exterminated. As the Tunis can not compete with the Merino in the production of wool, little was heard of the breed until the Columbian Exposition in 1893. After that several flocks were reestablished in the eastern and southern states. They are unusually hardy sheep, able to shift for themselves under widely different climates, as neither heat nor cold affects them adversely. The ewes are unusually fertile and will mate at almost any season in the year.

The Type. — The Tunis is medium in size, rangy, and an early-maturing breed. Rams in good breeding condition weigh about 180 pounds, and the ewes around 140 pounds. Both sexes are hornless. The face is brown and covered with short hairs; the ears large, broad, and pendulous; and the wool is white, brown, reddish, or of mixed color. The tail is distinctly broad and fat and serves as a natural storehouse to carry the animal over periods of famine. The meat qualities are good, but fat lambs and sheep are "patchy" about the tail head, this characteristic often causing lambs to be docked as much as 2 pounds. The fleece is coarse and harsh, and reasonably long. The weight of the unwashed fleece varies from 6 to 12 pounds.

Adaptability to Range and Farm. — The Tunis is widely distributed and seems to be especially well adapted to warm climates. For this reason Tunis sheep are found in limited numbers in the southern states and on the dry, sparsely vegetated ranges of the Southwest. In various parts of the Southwest, Tunis rams have given good results when crossed with the native range ewes.

The cross has usually resulted in increased size and improved quality of wool. When handled in good-sized bands, Tunis sheep flock together well and herd satisfactorily.

THE CORRIEDALE

The Corriedale was founded in New Zealand in rather recent years. The breed is the result of an effort to establish the desirable characteristics of the first cross between a long-wooled sheep, notably the Lincoln and the Leicester, and a Merino — characteristics desired in certain parts of New Zealand. Through persistent culling and selection a breed has been produced which maintains a good balance of mutton and wool. The first Corriedales were imported into the United States from New Zealand in 1914.

The Type. — The Corriedale is pure white with a cap of wool over the head, sometimes extending beyond the eyes, but with a hairy white face. The mutton lines are well developed, the back, loin, and hind quarters being of excellent form. Rams weigh about 225 pounds, and ewes from 150 to 160 pounds. As a mutton producer the Corriedale is quite a success, especially in view of its early-maturing qualities. The fleece has a long staple, is medium fine, and of good weight. The best ewes shear annually an unwashed clip of from 12 to 14 pounds. The wool is in demand and commands a high price.

Adaptability to Range and Farm. — Corriedales give a high percentage of lambs, 120 per cent often being recorded under favorable range or farm conditions. The breed is early-maturing, hence is suitable for the production of winter or early-spring lambs, as on farms in the milder climates. The fact that Corriedales flock well, and are active grazers and good rustlers on sparsely vegetated lands, makes them equally well adapted for range or farm pasture. It must be admitted, however, that a band of Corriedales will travel farther than a band of Merinos, but they are not particularly difficult to herd. The Corriedale seems to have combined the desirable mutton qualities of the long-wooled breeds, and the hardiness and wool qualities of the Merino, making it a very desirable general-purpose sheep.

QUESTIONS

1. Name the different breeds of middle or medium-wooled sheep that are popular in the United States.
2. Where did the middle-wools originate? Why are there so many breeds?
3. What are the most desirable characteristics as well as the chief undesirable qualities of the Southdowns? Shropshires? Hampshires? Oxford Downs?
4. What are the most desirable characteristics as well as the chief undesirable qualities of the Suffolk Downs? Cheviots? Dorset Horn? Tunis?
5. Which of the medium-wooled breeds are well adapted to the range? To the farm? Both the range and farm?
6. Which of the middle-wooled breeds would you select for the production of "hothouse" or early-spring lambs? Why?
7. Under what conditions would you cross high-grade fine-wooled ewes with a mutton type of ram? Would you retain the superior crossbred ewe lambs for breeding purposes? If not, why?
8. What breed of sheep leads all others in numbers in the United States? What breed ranks second?

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CHAPTER V

JUDGING THE QUALITIES OF SHEEP

Few beginners in sheep raising have in mind the ideal type of animal which they wish to perpetuate. That must come with experience and knowledge of the points of the animal that make for desirable qualities. If one hopes to attain the highest success in the business, whether lambs are to be raised for market or for breeding stock, it is important to become a judge of good sheep.

Factors such as climate, natural forage conditions, elevation, and ruggedness of country tend to influence the qualities of sheep. The effect of climate is outstanding. Willamette Valley in Oregon, now famous for its long-wooled sheep, was once partly occupied by fine-wools, chiefly the American Merino. The long periods of heavy rainfall stimulated germination of seed which accumulated in the sheep's wool, causing the sheep to turn literally into "green backs." This condition materially lowered the market value of the wool, hence the Merino breeds can not be grown profitably in that region. The later introduction of the Lincoln, Cotswold, and other long-wooled breeds met with remarkable success. Their long locks are a distinct advantage as they have a tendency to shed water.

CLASSIFICATION OF SHEEP

To be able to judge sheep according to their utility and merit, one must know how they are classified. There are two general classifications: (1) on the basis of types and breed, and (2) according to their value when sold on the market for mutton. When sheep are sold for slaughter, the development of the valuable mutton cuts is carefully judged (Fig. 22).

Classification According to Types and Breeds. — On the basis of breeds and types, classification is somewhat puzzling because

there are nearly as many classes as there are breeds. Some authorities have based their distinctions upon the color of the face, the presence or absence of horns, the topographic characteristics of the region in which the breeds originated, and upon the character of the wool, which is widely varied.

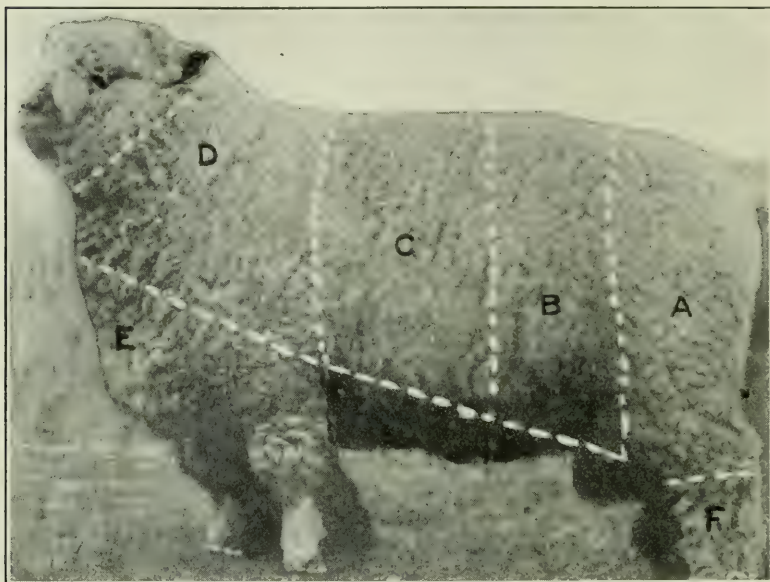


FIG. 22. — MUTTON AND LAMB CUTS AND THEIR LOCATION ON THE LIVE SHEEP.
A — leg; B — loin; C — ribs; D — shoulder; E — breast; F — shank.

The classification that is least variable in character and most important commercially is the one based upon the fineness of the wool as given below:

<i>Fine-wools</i>		
American Merino	Delaine Merino	Rambouillet
<i>Middle or Medium-wools</i>		
Southdown	Suffolk	Lonk
Shropshire	Cheviot	Ryeland
Hampshire	Welsh Mountain	Kerry Hill
Oxford	Tunis	
Dorset Horn	Exmoor Horn	

Long or Coarse-wools

Leicester	Romney Marsh	Black-faced Highland
Cotswold	Wensleydale	Karakul
Lincoln	Dartmoor	Persian

Woolless

Barbados	Barbary
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Classification According to Market Demand. — By market sheep is meant all those sheep that are sold on the livestock market. The market never inquires into the breeding of sheep. What it demands is the best development of those cuts which make good mutton. Allowance, of course, is made for the wool the sheep carry. Sheep that go to market are classified as follows:

<i>Fat or mutton sheep</i>	<i>Feeder sheep</i>	<i>Breeding sheep</i>
Lambs	Lambs	Ewes
Yearlings	Yearlings	Rams (bucks)
Wethers	Ewes	
Ewes	Wethers	
Bucks and stags		

Fat or Mutton Sheep. — It is the aim of all breeders of mutton sheep to meet the requirements of the butcher. The main qualifications of a desirable carcass are weight, form, quality, and condition.

Weight must be considered in connection with age and fatness because all these factors may influence quality. Weight is also influenced by breed. Too much weight is objectionable as it often indicates coarseness. *Form*, likewise, must not be overlooked. The general form should give a plump, smooth, and even appearance. The leg of mutton, in particular, should be full and heavy, and the back broad with deep, full loin. *Quality* implies refinement as opposed to coarseness, a factor usually associated with good breeding. Sheep of good quality fatten rapidly. Desirable quality is indicated by the head and other parts of the animal being of medium size and clean cut, and with mellow skin, and soft hair on those parts not covered with wool. *Condition*, or "finish," refers to the degree of fatness. The

carcass of an ideal butcher sheep has a smooth finish with the fat evenly distributed over the body.

Feeder Sheep. — In judging feeder sheep one should keep in mind the type that best meets the demands of the butcher, as sheep of this type are the most profitable. A vigorous constitution, ability to consume a large amount of feed, and to transform it into valuable meat at the least possible cost are the chief requirements. These characters are associated with a wide, deep chest, good depth of barrel, and well-sprung ribs that give ample room for the digestive and other vital organs. A large, deep body; a short, broad head with fine ears; full, bright eyes; strong lips; open nostrils; a thick, short neck; and short legs set wide apart are indicative of thrift, vigor, good constitution, and high dressing capacity.

Quality, in the feeder, as in the fat sheep, adds to the value of the carcass both in the percentage of dressed weight and in the edible quality of the meat. Quality is invariably associated with high money returns for feed consumed.

Feeder sheep should have a fairly straight, full outline and they should be neither fat nor especially lean. Very thin lambs, for instance, can not be expected to reach prime condition in the ordinary feeding period; they are, moreover, less likely to possess the thrift and constitutional vigor necessary to make gains comparable to those made by animals in moderately good flesh.

Breeding Sheep. — All the characteristics of excellence in constitution, conformation, and quality that are so important in butcher and feeder sheep are even more important in the breeding class. Since "like begets like" the use of high-class breeding sheep is the only means by which high-grade butcher sheep can be produced. In this connection the breed and the sex characteristics are not to be overlooked. Furthermore, emphasis should be placed on the more important characteristics of the fleece, the color of the skin, and the constitutional vigor and thrift of the animals.

The Ewe. — The ewe must possess not only all the requisites of the fat sheep in general form and quality, constitutional vigor, and feeding and flesh characters, but she must also have a strong

maternal nature and present a feminine appearance. The ewe should have finer features about the head and a more slender neck than the ram. Rough ears, with a plain, heavy head and neck, and a lack of refinement and femininity are rarely satisfactory.

The Ram. — As head of the flock, the ram may be considered one-half of it. Therefore, he should be a purebred and should show unmistakable breeding characters of quality in order to improve and maintain superiority in the flock.

As indicative of prepotency, the ram should show a good deal of sex character — that is, he should have the distinct appearance of a ram. He should have good size, distinctly masculine appearance, such as burliness (but not coarseness) of the head, with good thickness of neck. He should have good vigor and a bold, energetic look, with bright, clear-cut eyes. The nostrils should be widely distended; the loins thick and heavy; the rump and thighs broad and full; chest and brisket full and strong; the back smooth; the hips well covered and the flank straight, deep, and level. The fleece should be dense, long, and of superior quality.

HOW TO HANDLE SHEEP IN JUDGING

The wool may cover many defects in the form of the sheep. Therefore, after having surveyed the animal ocularly one can make sure that the first impressions are correct only after verifying them by handling. In the show ring and in the sale pavilion, verification of the ocular impression of the animal is of the greatest importance because of the common practice among breeders of trimming down any ragged and patchy parts of the wool which may conceal defects in the animal's form.

General and Specific Examination. — The first observations will be general in character and should take into account such points as the cleanness of the bone and the nature of the hair. This examination is followed by a more detailed observation of the various parts. It is a good plan to examine first those parts of the animal which furnish the more valuable cuts of meat, such as the leg of mutton, the loin, and the rump.

Both hands should be used in judging the leg of mutton. Careful note should be made of its size, fullness, firmness, and thickness. Then the depth and breadth of the twist should be noted. This is done by placing one hand between the legs and the other at the head of the tail. Following the detailed observations, the examination should be continued over the entire body. In examining the head, for instance, one should note its general shape, the width of the forehead, the character of the eyes, and the degree of hornlessness of breeds that are not supposed to possess horns.

In examining the fleece and skin it is necessary to open the fleece here and there. Since the best wool is found on the side of or immediately beneath the shoulder, these parts should be examined first. The fleece should be opened by placing both hands on the surface, gently forcing it apart. The density, quality, condition, color, and luster of the wool should then be carefully noted.

Estimating Age of Sheep. — The sheep has a set of eight incisors on the lower jaw in addition to the molars at the back of the upper and lower jaws. With a little experience, the age of a sheep, up to its fifth birthday, may be closely estimated by noting the appearance of the incisors.

At four weeks of age there are eight temporary incisors, or "milk" teeth. When the sheep is a little more than a year old the central pair of incisors is replaced by permanent teeth. These are broader, wider, and of stronger appearance than the temporary ones. At the age of two years the next pair is replaced; the next pair when the sheep is about to reach its third birthday; and the fourth, or outer pair, when the sheep is approaching its fourth birthday. Thus a "full mouth" or a complete set of permanent incisors is evidence of the fact that the animal is not less than four years old. After the sheep is four years old it is not possible to judge its age accurately by the teeth. After the fifth birthday the age may be determined approximately, however, by the *condition of the teeth*. With age the teeth wear down and spread and protrude forward. While the spreading of the teeth is determined to some extent by the

character of the feed upon which the animal has subsisted, experienced sheep raisers become fairly expert at judging a sheep's age after its fifth year.

In examining the mouths of sheep one should avoid rough handling. The mouth can be readily opened and the teeth well exposed if, while parting the lips with the first two fingers of the free hand, the head is held steady by pressing it firmly against the thigh (Fig. 23).



FIG. 23. — HOW TO HOLD THE SHEEP IN ESTIMATING ITS AGE.

QUESTIONS

1. Why is it necessary to become a good judge of sheep in order to be a successful producer, either of purebreds or of feeder sheep?
2. How do sheep compare with cattle in number of breeds?
3. How are sheep classified according to types and breeds?

4. How are sheep classified on the market, and what ages and sexes do the respective classes include?
5. Name the chief qualifications for a high-grade mutton sheep.
6. What are the most important factors to keep in mind in judging feeder sheep?
7. What are the outstanding characteristics of a good breeding ewe?
8. Discuss in detail the characteristics of a good ram.
9. (a) Up to what age is it possible accurately to judge the age of sheep by their teeth? (b) Describe the mouth (teeth) of a sheep that is a little more than a year old; two years of age; four years of age.

NOTE. — The bibliography for this chapter is placed at the end of Chapter IX (page 148).

CHAPTER VI

LIVESTOCK HANDLING IN RELATION TO SEASONAL PLANS OF PASTURE USE

The various methods of improving the grazing capacity of ranges and farm pastures have been discussed in the author's previous books. His more recent investigations have brought to light the importance of grazing at certain definite periods according to the degree of development of the plant cover. The results of these studies and their application in the handling of foraging animals are summarized in this chapter.

When the kind of livestock best suited to graze upon a given pasture area has been selected, the next step is to adopt a plan of management which will net the biggest returns from the area over an indefinite period. To accomplish this, three phases should be avoided to the greatest extent possible, namely: (1) grazing very early in the spring; (2) pasturing down the forage too frequently in a single season; and (3) grazing too close late in the season. It is the aim of this chapter to show, first, why disregard of the points enumerated is costly, and second, how certain bad practices can be most conveniently corrected.

WHEN THE GRAZING SEASON MAY BEGIN

The correct time to commence grazing in the spring is recognized as that period when the forage plants have attained sufficient size to continue to grow vigorously after being grazed down, and when the vegetation as a whole will maintain livestock in thrifty condition.

Researches indicate that no period in the use of pasture vegetation is more critical than this period of early spring. When the earliest weeds of the spring range begin to appear, the forage of the winter range, and often hay and concentrates, are exhausted. At this early stage of forage growth there is a great

temptation to turn the animals on the pasture "for just this season." But alas! A single season of such early pasturing has serious effects.

Indications of Beginning of Spring Grazing Period. — Although investigations have been under way for many years to determine when grazing on different types of range may begin, the problem has by no means been solved for all pasture types. Such information as is available, however, is exceedingly valuable, and the basic principles are reported here. Although the plants and the range areas used to illustrate the various points may differ somewhat from those with which the reader is concerned, the writer believes that the principles evolved are broadly applicable.

From 1916 to 1922 the author and associated workers conducted grazing-season studies in the Wasatch Mountains of Utah.¹ Selected forage plots were clipped to simulate grazing, beginning when the plants were only about 2 inches in height, and continuing until they were a foot or more in stature. One important problem to be solved was whether a certain growth in height of grasses and other herbs would clearly indicate when the pasture could be grazed without injury.

Weak growth and small yields of forage were invariably recorded a few weeks after very early spring clippings of bunchgrass plots (Fig. 24). The yield in air-dry forage on plots where the grasses averaged about 2 inches in height when first harvested was approximately one-third as much as when the average height growth had reached about 6 inches before being clipped.

In all cases the amount of forage procured from the second cutting was appreciably larger where the grasses and other herbs had attained a height of not less than 6 inches before they were first clipped. The following important genera of native plants were worked with: Needlegrass (*Stipa*), brome grass (*Bromus*), wheatgrass (*Agropyron*), false dandelion (*Agoseris*), and *Geranium*.

The study brought out the fact that when bunchgrasses and

¹ Sampson, Arthur W., and Malmsten, Harry E., "Grazing Periods and Forage Production on the National Forests." U. S. Dept. of Agr. Bul. 1405, 1926.

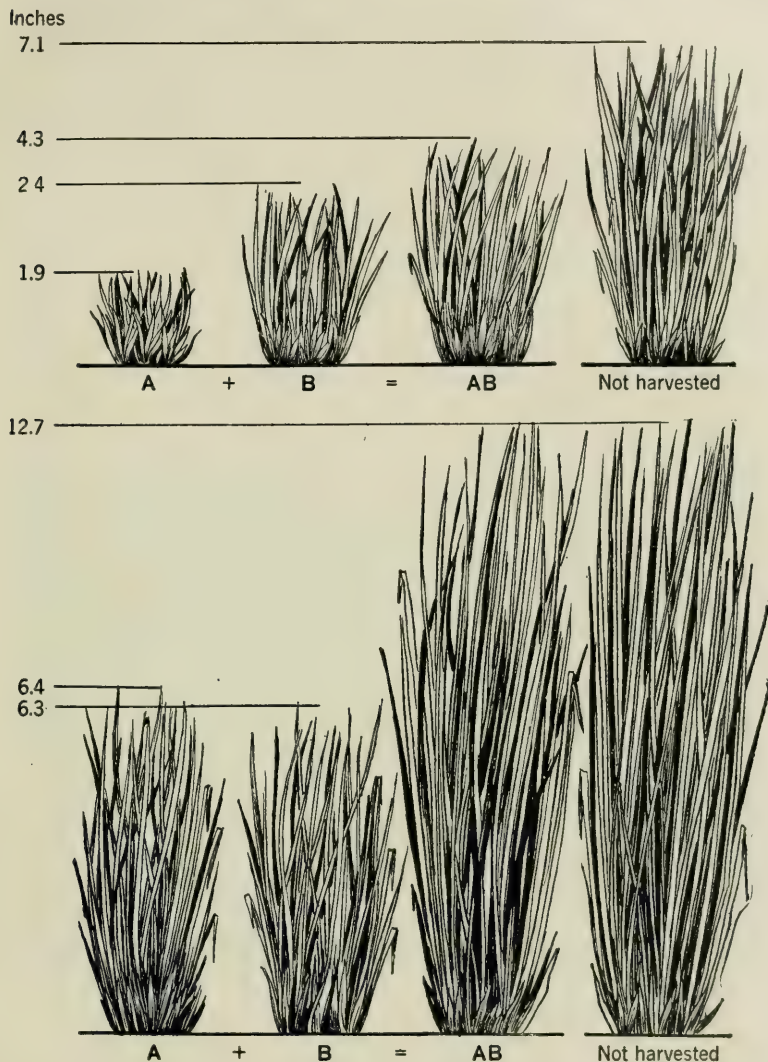


FIG. 24. — COMPARATIVE GROWTH OF NEEDLEGRASS WHEN GRAZED AT DIFFERENT STAGES OF DEVELOPMENT IN THE SPRING.

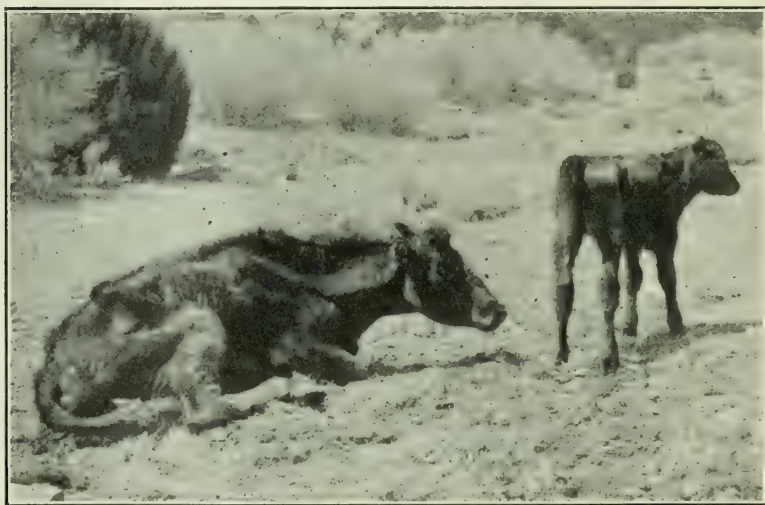
Above (A) represents plants harvested (clipped) June 1, when they had grown to a height of 1.9".

On June 20 (A) was harvested again and the plants had at that time attained a height of 2.4", the two harvestings (June 1 and June 20) thus showing a combined growth in height of 4.3" (AB).

Plants which were not harvested made a total growth of 7.1" for the corresponding period.

Below, (A) represents plants harvested June 20 when they averaged in height 6.4". These plants were again harvested 20 days later (represented by B), when they had grown to a height of 6.3", making a combined growth (AB) of 12.7". The non-harvested plants did not make any more growth than those represented by (A).

similar vegetation, the spring growth of which is 2 to 4 inches in height, are grazed down so that only about 1 inch of the leafage remains, they cannot elaborate sufficient food to rebuild the leafage grazed and at the same time replenish the limited food supply in the roots and crown of the plant. On the other hand, when grass leafage 6 to 8 inches in height is grazed the plant has already stored sufficient food in its underground cells to be able to push forth new leafage vigorously. This new growth elaborates ample food for the use of the plant as a whole, and soon much nutritious forage is again available for pasturage. When grazing is sufficiently delayed in the spring, the later herbage growth is as rapid as in vegetation not grazed.



(Forest Service.)

FIG. 25. — TOO EARLY GRAZING IS RESPONSIBLE FOR POOR AND WEAK LIVESTOCK.

The loss of this cow and calf is inevitable because the cow is so weak she cannot get on her feet.

The practice of grazing early in the spring when the soil is watersoaked not only destroys the roots of the plants but also packs the soil heavily, and causes it to bake and crack in hot weather — incidentally bringing about erratic runoff. The result is a stunted and scant growth of forage, insufficient to

nourish the animals satisfactorily; hence they lose in weight and condition and sometimes die from starvation (Fig. 25).

Species like dandelion, yarrow, and sweet cicely, whose basal leafage spreads over the ground to form rosettes, and even shrubby vegetation, are generally ready for pasturing when the main grasses have attained a height of 6 to 8 inches.

Temptation to Open Grazing Season too Early. — On elevated pastures, as in the mountains of Utah, certain plants of practically no forage value come into full bloom about one week after growth has started. The following plants, because of their rapid early growth, may be classed as "false indicators" of when spring grazing may begin, for they appear before the dependable forage plants have attained adequate growth (Fig. 26):

Steers-head (*Bikukulla uniflora*)^{2,3}

Spring beauty (*Claytonia lanceolata*)

Small adder's-tongue, or dog-tooth violet (*Erythronium parviflorum*)^{2,3}

Waterleaf (*Hydrophyllum capitatum*)

Indian potato (*Orogenia linearifolia*)^{2,3}

Newberry bladder-pod (*Physaria newberryi*)³

Smooth buttercup (*Ranunculus glaberrimus*)^{2,3}

Tongue-leaved violet (*Viola linguaefolia*)

When the plants listed above are in full bloom, such important forage as the wheatgrasses and the needlegrasses have just started to grow vigorously (usually the leaf blades are less than 2 inches in length), and the leafage of the forage cover is generally just beginning to show. A common danger at this early stage is the fact that many poisonous plants begin growth with the earliest of the showy weeds, hence when grazing is commenced too early heavy livestock losses sometimes occur, particularly among cattle, from larkspur poisoning, and among sheep, from death camas.

² Common in the oak-brush type (Transition zone).

³ Common in the aspen-fir type (Canadian zone). Plants not otherwise designated are common in the Transition, Canadian, and Hudsonian zones.



(Forest Service, under direction of the author.)

FIG. 26. — EARLY-GROWING PLANTS THAT LURE STOCKMEN TO TURN THE ANIMALS ON THE RANGE BEFORE THE FORAGE IS PROPERLY DEVELOPED.

(a) Indian potato (*Orogenia*) (b) Buttercup (*Senecio*) (c) Violet (*Viola*) (d) Dog-tooth violet (*Erythronium*) (e) Spring beauty (*Claytonia*)

Plant Guide for Opening Grazing Season. — The following plants have served as “key” species for judging when grazing should begin on mountain range. The list may well serve as a general guide on elevated pastures elsewhere than in the region studied:

Bluestem (<i>Agropyron smithii</i>)	Plant 6 to 8 inches high; no flower stalks showing.
Violet wheatgrass (<i>Agropyron violaceum</i>)	Plant 6 to 10 inches high; no flower stalks showing.
Mountain brome (<i>Bromus polyanthus</i>) ^{5,6}	Leaf blades 6 to 10 inches high; no flower stalks showing.
Downy brome (<i>Bromus tectorum</i>) ⁴	About 6 inches in height, panicles conspicuous.
Fendler bluegrass (<i>Poa fendleriana</i>) ⁴	Nearly all in flower head; blossoms beginning to open.
Letterman needlegrass (<i>Stipa lettermanii</i>)	Plant 6 to 8 inches high, no flower stalks showing.
Yarrow (<i>Achillea lanulosa</i>)	Leafage 2 to 4 inches long; flower stalks beginning to show.
Water parsnip (<i>Aulospermum longipes</i>) ⁴	Finished blossoming, seeds well developed.
Balsamroot (<i>Balsamorhiza sagittata</i>) ⁴	At least 25 per cent of plants in blossom.
Low larkspur (<i>Delphinium menziesii</i>)	Leafage conspicuous, beginning to blossom.
Wild geranium (<i>Geranium viscosissimum</i>)	Leafage about 4 inches high, approximately one-fourth developed.
Dandelion (<i>Leontodon taraxacum</i>)	Leafage about one-half developed, blossoms beginning to appear; a few blossoms opened.
Butterweed (<i>Senecio columbianus</i>) ^{4,5}	Basal leafage mature, plants beginning to blossom.
Foothill death camas (<i>Zygadenus paniculatus</i>) ⁴	Leafage mature, plants beginning to blossom.
Serviceberry (<i>Amelanchier alnifolia</i>) ^{4,5}	Leaves $\frac{1}{2}$ to 1 inch long and from $\frac{3}{8}$ to $\frac{3}{4}$ inch wide; flower buds about to open.
Birchleaf mahogany (<i>Cercocarpus montanus</i>) ⁴	Leaves $\frac{3}{8}$ to $\frac{1}{2}$ inch wide and $\frac{1}{2}$ inch long; no flowers showing.
Bitterbrush (<i>Purshia tridentata</i>) ⁴	Leaves $\frac{1}{4}$ to $\frac{1}{2}$ inch long and from $\frac{1}{8}$ to $\frac{1}{4}$ inch wide; flower buds swollen.

⁴ Common in the oak-brush type (Transition zone).

⁵ Common in the aspen-fir type (Canadian zone).

⁶ Common in the spruce-fir type (Hudsonian zone). Plants not otherwise designated are common in all three zones.

Snowberry (<i>Symphoricarpos oreophilus</i>)	6 to 14 leaves showing from each bud, no blossoms; new growth of stem about 1½ inches long.
Quaking aspen (<i>Populus tremuloides</i>)	Leaves unfolded, about the size of a 25-cent piece.

It is important that any of the above developmental stages be carefully checked on any range, as the same species, or closely related plants, may react somewhat differently in other localities. Even different slopes and exposures seem to influence species in slightly different ways.

Numerical Index of Plant Development. — Experience has emphasized the importance of *uniformity* in recording the stages of growth of pasture vegetation on different types, slopes, and elevations. The following phenological guide, expressing in a number the exact stage of development of important species with the advance in the season, has proved valuable:

Beginning of growth — buds of foliage and blossoms swelling (too early for grazing)	5
Leafage beginning to show — leaf or leaf blade slightly unfolding (too early for grazing)	10
Leaf sheaths swelling, inflorescence beginning to show, perennial grass herbage 6-8 inches high (ready for grazing)	30
Inflorescence showing but flowers not expanded (ideal for grazing)	40
Inflorescence showing, most of flowers fully expanded, leafage mostly developed (ideal for grazing)	60
Seed fully developed and disseminating (ready for deferred grazing)	90-100

Growth indices represented by "5" and "10" show for a given type that the season is not sufficiently advanced for grazing. An index with an average of "30" for several important forage species shows that grazing may begin. Indices of higher denomination show more or less the relative palatability and nutritive qualities of the forage. An index of "90" or higher indicates that grazing can commence on areas that have been withheld for purposes of revegetation. The application of the method here proposed should not be based on only one or two species. When the stage of development of several different species is recorded one procures a reliable average of forage development for a given range type. As the season progresses,

the accumulated data are entered on a chart, such as is shown completed in Fig. 27. A graphic picture of the development of some five pasture grasses, three broad-leaved herbs, and of not

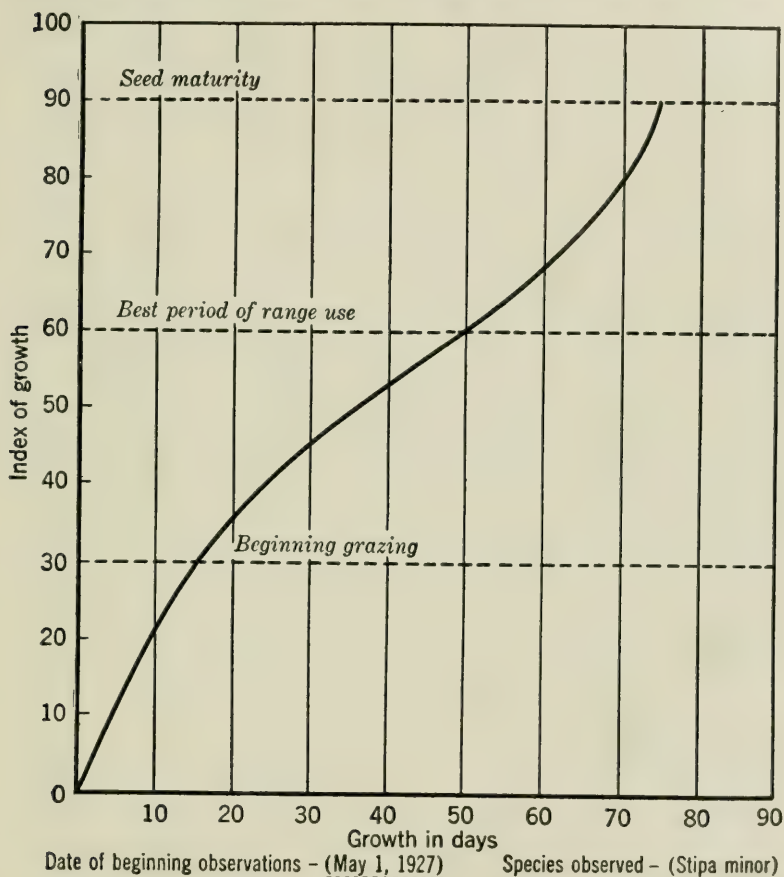


FIG. 27. — INDEX OF PROPER DATES FOR GRAZING WITHIN THE SEASON.

The index of growth (shown in vertical scale to the left) corresponds with the number of days of growth (shown in horizontal scale at bottom) as the season advances. With a numerical index of growth of 30, the forage is sufficiently developed for grazing. When the growth index is 60 the forage is ideal for pasturage; and when the index is 90, grazing may begin upon areas where deferred grazing is practiced for purposes of revegetation.

less than three shrubs, typical of a range type, should be recorded each season until reliable averages for management plans are procured.

Effect of Frequent Grazing on Vegetation. — The effect of frequent grazing, on the yield and life of the vegetation, is even more injurious than that of very early spring grazing. Bunch-grasses harvested four times at monthly intervals during the main period of growth, for example, were nearly all killed at the end of the third year of such treatment. In the first season the yield drops sharply; and in the second season the root development is poor and little leafage is produced (Fig. 28). The results

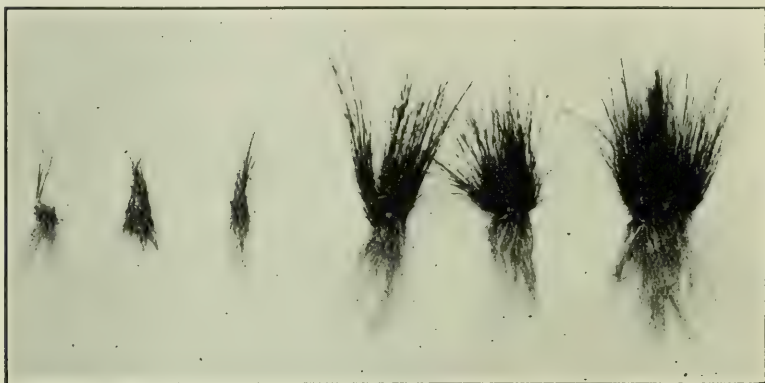


FIG. 28. — RELATIVE FORAGE PRODUCTION OF VIOLET WHEATGRASS HARVESTED WITH VARYING FREQUENCY FOR TWO YEARS IN SUCCESSION.

Left, plants harvested four times at monthly intervals for two years in succession; right, plants harvested one month after growth started, and clipped again at the end of the growing season.

are practically identical for all herbaceous plants that are devoid of rootstocks. Frequent grazing likewise causes a decrease in the yield of the comparatively few sod-forming pasture plants found in the West, but the results are less marked than in bunch-grasses.

The results of studies and extensive observations of lands actually grazed indicate clearly that maximum returns from the pasture cannot be expected over an extended period when the forage is grazed closely three or more times at, let us say, approximately monthly intervals during the growing season. A single year of such use causes a decline in the yield. But grazing moderately twice in a season, as in the spring or early summer and again in the fall, is not excessive in seasons of good growth.

WHEN THE GRAZING SEASON SHOULD CLOSE

Closing of Spring Range. — On mountain range of wide elevational variations, foraging animals are usually removed from the spring pasture when the plant cover of the summer range is properly developed for grazing. Aside from the stage of growth and abundance of feed on the summer range, however, the movement of the stock from the spring to the summer grazing grounds is determined by (1) the grazing capacity of the spring range and the palatability of the forage, (2) the water supply on both ranges, and (3) need for and value of the forage on the spring range for fall grazing.

Where a good balance exists in the forage cover of the spring and the summer range, the stock may be placed on the summer range as soon as the forage is ready for grazing. But if the forage on the spring range is more abundant than on the summer range the animals should be held on the spring range as long as the feed and water are adequate. With limited spring range and abundant summer pasture it is important that the stock be shifted to the latter as soon as the forage is ready for use. On all range units it is necessary to know when and where the water supply becomes exhausted. Range without stock water in the middle of the summer may often be fully utilized in the spring when melting snow and rain create the necessary water supply.

In some localities the aftergrowth on the spring range may be utilized to good advantage in the fall, or the spring grazing may be so light as to leave feed for fall use. This plan sometimes relieves the pressure for forage late in the season on the more elevated summer and early fall pastures.

Closing of Summer and Autumn Range. — Foraging animals should not be held on the summer and autumn pastures after only 15 to 20 per cent of the season's forage growth remains. It is never good management on any range to graze the forage so late in the autumn that it is only possible for the animals to eke out an existence. Beef cattle, in particular, should never be held so late on the autumn range as to lose in weight and condition.

Factors to keep in mind as to the time of closing the summer and autumn ranges are: (1) avoidance of too close forage utilization; (2) avoidance, as far as possible, of grazing in inclement weather and the trampling of wet soil; (3) the condition of flesh of the livestock; (4) availability of late autumn and winter forage elsewhere; and (5) availability of water.

Calendar of Grazing Seasons. — In the mountains of Utah the elevational extremes are from 6500 to 11,000 feet. The routine of operation with respect to periods of grazing is rather representative of similar mountain types elsewhere, hence the following dates should prove of some value in handling range in other localities:

Oak-brush type (6500 to 8000 feet elevation): Spring to early summer, and late fall; May 20 to June 9, and October 1 to October 15.

Aspen-fir type (7500 to 9500 feet elevation): Early summer to mid-summer, and late fall; June 10 to July 9, and October 1 to October 15.

Spruce-fir type (9000 to 11,000 feet elevation): Summer to fall; July 10 to September 30.

The date first given for each type represents the average time at which the range in the particular belt named is ready for grazing. This date varies somewhat from year to year according to the climatic peculiarities of the season.

MANAGEMENT PLANS BASED UPON GRAZING PERIODS

All classes of livestock tend to drift to the higher country when they are turned loose on the low-lying spring range. Sheep on open range are handled in bands under the vigil of a herder, and their movements are readily controlled. They can be held on a range unit until the forage is properly utilized, and then shifted to another area of suitable forage growth. Cattle, on the other hand, if merely driven on the range, will almost invariably drift to elevated areas that are not ready for grazing, in spite of abundant palatable forage, ample water, and shady nooks on the range where they are first left. It is quite as important to confine cattle as it is to confine sheep and goats to the pasture unit where the forage is properly developed for

grazing. To carry out a grazing plan that is clearly coordinated with the grazing periods, or with the extent of the forage development on the various types and vegetative zones, requires careful study in advance of the grazing season.

Division of Range Units. — The first step in grazing upon the various range units is to divide each unit into natural seasonal zones. In doing this, major vegetative zones or types are followed as strictly as possible. Advantage is taken of various boundaries, such as mountain barriers, streams, and fences, in confining the animals. Once located within a range unit the animals must be so distributed as to graze uniformly over the entire area. Where this is done local overgrazing is avoided.

The second step in the management plan is to divide the range into logical lateral and horizontal grazing units within the main zone. To do this effectively, the limitations of each zone and of the units therein must be known, and should be shown on a map. The correct grazing capacity of each unit must be known, as well as the season in which it can be grazed to best advantage.

Controlling Movements of Livestock. — The means of controlling cattle are salting, fencing, and herding. The locations of the salt grounds on the range afford one of the most satisfactory means of controlling their movements. Salt should be available when the animals first come on the range and should be distributed in accordance with the amount and period of development of the forage. Salt placed on slopes and ridges of the more remote parts of the range is effective in attracting cattle to these places and incidentally in obtaining even use of the forage. No salt should be placed within about 200 yards of water, near areas infested with poisonous plants, near recreation sites, or in places where the animals naturally congregate. It is well also not to leave salt on a pasture unit after its forage has been utilized and the animals located on a new area.

Some riding is necessary to get the animals properly placed on the range and to look after their needs during the season. Limited riding is also necessary to prevent the animals from drifting back to the range already grazed and to keep them away from lands not yet ready for grazing.

The cost of fencing is usually so high that fences can be constructed only in strategic places, as across gaps of ridges or across relatively narrow canyons.

A Specific Management Plan. — A practical application of the principles pertaining to proper grazing periods on a cattle range is here briefly given. Salting, herding, and a limited amount of fencing must be relied upon to secure good distribution within the units and to move the cattle from one unit to another.

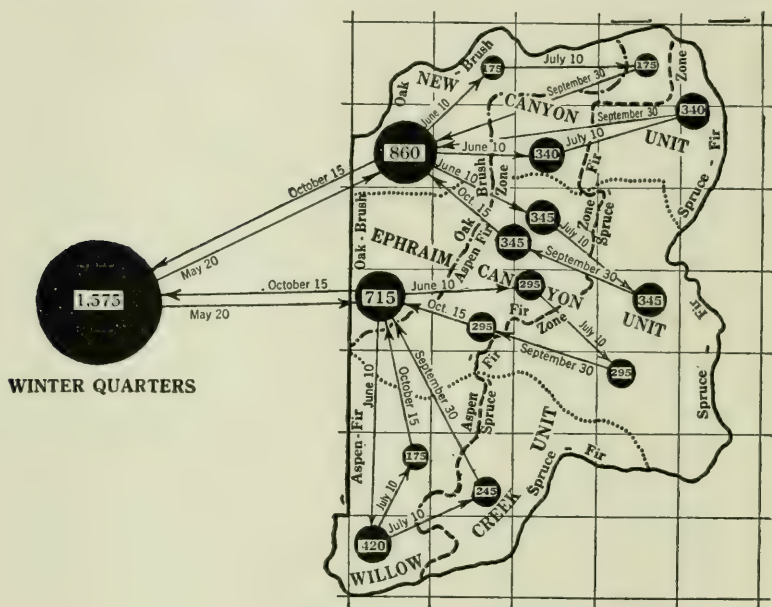


FIG. 29. — A CATTLE DIVISION ON SPRING AND SUMMER RANGE.

The 1575 cattle are distributed in the spring from the winter range according to the time that the forage is adequately developed in the different zones.

Figure 29 shows a range division, with vegetative types and zones of vegetation, and the proposed distribution and movements of 1575 cattle to secure proper seasonal use of the forage. The plan presented approaches the ideal as nearly as can reasonably be expected under present range-management practices.

The chart shows that 860 of the total number of 1575 cattle, admitted to the entire range for the season, are placed, from

May 20 to October 15, in the oak-brush zone of the New Canyon cattle unit. Of these, 340 are moved on June 10 into the aspen-fir zone of New Canyon, and on July 10 they are driven into the spruce-fir zone where they remain until September 30. After that, if they have not already drifted down they are driven to the oak-brush zone where they remain until October 15. A herd of 175 cattle is allowed to remain in the oak-brush zone until July 10 when they are drifted into the aspen-fir zone; and on September 30 they are brought back to the oak-brush zone to remain until the close of the grazing season.

The remaining 345 cattle, placed in the New Canyon cattle unit on May 20, are shifted on June 10 to the aspen-fir zone of the Ephraim Canyon cattle unit where they are grazed with 295 head moved up from the oak-brush zone of Ephraim Canyon. These 640 head are moved on July 10 into the spruce-fir zone where they remain until September 30. On that date they are drifted back into the aspen-fir zone to remain until the close of the season.

In addition to the 295 cattle which are later moved into the higher zones of Ephraim Canyon, 420 head are placed in the oak-brush zone of the Ephraim Canyon cattle unit on May 20, and on June 10 they are drifted to the aspen-fir zone of the Willow Creek cattle unit. Of these, 175 head remain in the aspen-fir zone of the Willow Creek unit until the close of the season. On July 10, 245 cattle are moved into the spruce-fir zone of Willow Creek, and on September 30 these are drifted back to the oak-brush zone of Ephraim Canyon. It is clear that these numbers of cattle are relative. By careful organization the movements of cattle on rugged range can be well controlled. Such control pays both in the improvement of forage conditions on the range and in the production of more and better beef.

The plan of management here demonstrated for cattle applies also to sheep, in that uniform, conservative use of the range should always be practiced. (See Chapters on management of cattle and sheep on the range.)

QUESTIONS

1. Name several indications which show when the stock may be admitted on the spring range.
2. Why is very young pasture forage injured by grazing?
3. (a) What factors often cause stockmen to open the grazing season too early? (b) Name several "plant guides" to show that the forage is sufficiently developed for pasturing.
4. What factors determine the closing of the spring range and the beginning of grazing on the summer range?
5. When should grazing be discontinued on the summer and autumn ranges?
6. Discuss the calendar of grazing periods as carried out on a typical spring range of low elevation and a summer and fall range in the mountains.
7. Discuss fully a cattle-management plan based upon proper grazing periods.

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CHAPTER VII

RAISING SHEEP ON THE RANGE: CAMP TENDING, HERDING, BEDDING, WATERING, AND SALTING

For many years the far western states have been the main breeding grounds of sheep in this country. In the eastern states climatic conditions prevent the use of pasture forage in the winter unless it is harvested and stored. But in the great American desert region grasses and many other stock food plants cure well on the ground, and the relatively small precipitation received during the winter does not seriously impair their food value. On the Pacific Coast also, where growth makes grazing upon succulent forage possible, many sheep are wintered on green pasture. In the summer a considerable proportion of the bands graze on the cool mountain ranges.

General Considerations. — Millions of acres of pasture lands are to be found in every state in the West, but, to those unfamiliar with arid or semi-arid conditions, the vegetation appears entirely inadequate for sheep grazing. On some extensive ranges the plants relished by livestock are widely spaced, and sheep, like other kinds of livestock, graze over a large area in the course of a day.

It is significant that in 1850 only $1\frac{1}{2}$ million sheep, or 7.6 per cent of the total number in the United States, were found west of the Mississippi River. In 1910 approximately $37\frac{1}{2}$ million head, or 71.8 per cent of all the sheep in the United States, were raised west of the Mississippi. In 1925, not less than $25\frac{1}{2}$ million sheep, or 65.5 per cent of all the sheep in this country, were found in what are termed the twelve chief western range states.

The percentage of lambs raised varies in the different geographical areas. The following figures, given by the agents of the Tariff Board, are based on the number of lambs old enough to be marketed. These figures vary somewhat from year to year but they are nevertheless of comparative significance and interest.

<i>State</i>	<i>Per cent</i>
Arizona.....	59.3
California.....	76.4
Colorado.....	61.9
Idaho.....	67.2
Montana.....	71.9
Nevada.....	74.6
New Mexico.....	57.7
Oregon.....	79.6
Utah.....	72.5
Washington.....	92.5
Wyoming.....	62.4
<i>Average.....</i>	<i>70.5</i>

These figures would indicate that better range husbandry is practically an economic necessity if sheep raising is to be a success. Old wasteful methods of handling sheep on the range are now slowly giving way to new and better ways. The native forage is being more carefully husbanded, and in many localities farm crops are grown to supplement the natural grasses during severe summer droughts and in adverse winters. One of the chief causes of injury to the unregulated range has been, and still is, brought about by the tramp sheepman — the man who owns no land and has no headquarters ranch. Local growers know that overcrowding, which is the usual result of the tramp grazer's coming in, will ruin any previous efforts toward forage improvement.

The lands grazed by sheep are usually the rougher areas of the plains, foothills, and mountains. All grazing types should be properly controlled if the best conditions for the bands are to prevail permanently. The mountains furnish excellent forage for the sheep during the summer months, for there is usually an abundance of water and good pasturage, and the days are cool and invigorating. The plains and other low lands, which are too hot and dry in summer, furnish excellent winter range, whereas during the spring and fall the foothills are utilized to good advantage. For grazing throughout the year, the acreage requirements vary widely, being commonly from 4 to 20 acres for a mature sheep.

Calendar of Operations. — The year's calendar for operating a band of sheep may be summarized as follows:

Spring — lambing season; docking, castrating, and marking; shearing; dipping; delivery and sale of wool; drive to the summer range.

Summer — summer range husbandry; sale of lambs.

Fall — drive back to winter range; dividing the flocks; sale of lambs; dipping, if necessary; breeding.

Winter — winter range husbandry; supplementary feeding if pasturage is insufficient.

Duties of the Camp Tender. — A good camp tender must know sheep and understand their needs. He decides on the next headquarters camp site — an important question; breaks camp; helps with the cooking; keeps the camp, burros, and other pack and saddle animals supplied with food; brings in the sheep's supply of salt; helps count the sheep; locates strays; and has many other duties. The daily counting of the sheep is not an actual count, but is made by counting the black sheep and the ones with bells, and deciding if the band as a whole is intact. Another duty of the camp tender in winter is melting snow to water the saddle and pack stock, and for camp use.

If several bands of sheep are owned by one person, the camp tender may have as many as five bands under his charge. Sometimes an assistant camp tender is provided. The bulk of the provisions is then kept at a headquarters camp and from this point distributed to the camps of the herders as needed. The pay of the camp tender is usually larger than that of the herder as his responsibilities are greater.

On the ranges of the Northwest the camp tenders and herders are usually of Anglo-Saxon descent and they receive higher wages than in other sections, and in general they enjoy better food. In California, Anglo-Saxons, French Basques, Portuguese, and some Mexican herders are to be found. The men handling the bands in the Southwest are nearly all Mexicans.

Duties of the Herder. — The life of the herder is a busy one if he is conscientious and practices the most approved methods of handling the band, such, for example, as "bedding out" the sheep — that is, making camp in a new place each night. In the

morning the herder must pack his tent, supplies, and bed on the patient burro. With the camp baggage on its back, the burro picks his feed along with the sheep. To make sure that the camp supplies will be at hand at night, the pack animal is given a few handfuls of grain once or twice a day. For this he is usually on hand. Once a week the camp tender usually packs the necessary supplies to the herder.

Adequately to protect the band from its enemies and to direct its course of travel, the herder should be with the sheep from the time they leave the bed ground early in the morning until they are "shaded up," which is usually about 9 A.M. Also, he should watch over them late in the afternoon. In doing this the experienced herder will not follow the sheep closely or drive them about unduly. A good herder has little time to waste. He is directly concerned with (1) the care of the band under his charge; (2) the method of herding and the general handling desired by the owner; (3) the type of country and the selection of suitable bedding grounds; (4) the assembling of the sheep for the night; (5) the habits of the band with reference to the time the sheep are accustomed to leave the bedding ground in the morning; (6) the avoidance of losses from poisonous plants and predatory animals; (7) the availability of water for the sheep and an adequate supply of salt — in short, the general welfare of the band and the facilities with which to meet its requirements.

As the cost of herding on the range is a heavy item of expense, there is a strong tendency to give the herder more animals than he can properly care for. If the band is composed of wethers one herder can handle from 2000 to 2500; if it is a band of ewes, he can care for from 1000 to 1400 and their lambs; if it is a band of dry and wet sheep, about 1500, not including the lambs. Except in extraordinary cases, larger bands than the numbers given should be avoided in order to protect the range from excessive trampling and at the same time give all the sheep a good chance to graze. Many highly successful range sheepmen who own large numbers of sheep will not have more than 1200 ewes and their lambs in a band, with a preference shown for bands numbering 1000 ewes with suckling lambs.

Some growers have as many as 3000 to 3500 dry sheep in one band. On summer range, not more than about 2000 dry sheep should be banded together. Generally the lambs in a band of more than about 1200 ewes do not make the most rapid growth. On National Forest range the bands are not permitted to exceed approximately 1500 ewes, not including their lambs, or from 2000 to 2500 dry sheep.

The herder's responsibilities are heavy when the value of the sheep and the maintenance of the range, for which he is responsible, are considered. A band of 1000 range ewes and their lambs is a comparatively small unit, yet it is worth from about \$7000 to \$12,000. The growth made by the animals, the losses suffered from accidents, from predatory animals, and from diseases, and the improvement in and maintenance of the forage crop are largely in the hands of the herder.

Many students of range livestock husbandry believe it would pay sheep breeders to give their herders a bonus for every additional 5 pounds over a certain weight which they put on the lambs in their band. This would tend to create greater interest in securing the best pasturage available for the flocks as the season progressed and would insure that the animals were not trailed unduly or worked excessively by dogs; that they were not brought back to the same bed ground for a number of nights in succession; and that they were not seriously molested by predatory animals. A bonus plan would not only afford the herder an opportunity to make an additional profit but the owner of the sheep would likewise be repaid, with no chance to lose. It might also help solve one of the greatest difficulties which the western sheep grower faces today — the problem of securing reliable herders and camp tenders. When a herder quits at a moment's notice and a new man of questionable experience is hired to take care of the sheep, "cuts" from the band, mixing with other herds, trespassing, and undergrown lambs are likely to be the result.

Quiet Handling and Open Herding. — Sheep are naturally timid animals and it is essential to handle the band quietly and to guard it from alarms (Fig. 30). For this reason the use of

dogs, except as a safeguard against predatory animals, and to locate strays, is not advocated by those who are most successful with their ovine charges.

On the range the best policy is to allow the sheep to commence grazing as early in the morning as they will. Some herdsmen do



(Forest Service.)

FIG. 30. — SHEEP GRAZING QUIETLY UNDER THE BEDDING-OUT SYSTEM.

Such open, quiet herding gives each sheep an equal chance to crop on choice forage, without injury to the range.

not permit the flock to leave the camp early but “throw in the dogs” and compel those that are starting to leave the bed ground to return. This is done because the herder has not left his bed or has not had his breakfast. It is a poor practice, for the sheep will usually settle down for an hour or two, and the cool of the morning, which should be used for grazing, is lost.

Results of Herding With Dogs. — The assistance of dogs in herding seems to be on the decline, and there is a steadily growing sentiment among owners in favor of having the herder direct and check the wanderings of the band under his charge, unassisted by dogs. Some experienced sheepmen insist that heavier losses are incurred on the western ranges by the use of dog helpers than by sheep-killing dogs on the southern and eastern farms.

Figure 31 shows the band massed together in typical fashion as a result of the work of dog herders.

Ewes, particularly during the lambing season and when with their lambs on the summer range, should never be chased by a dog. At such times one of the first duties of the shepherd should be to keep dogs, as well as all other animals of a disturbing nature, away from the ewes and their offspring.



(Forest Service.)

FIG. 31. — SHEEP CLOSELY HERDED BY CANINE HELPERS.

Close herding and the liberal use of dogs in handling the band prevents the best growth of the lambs, makes the ewes nervous and discontented, and injures the forage by excessive trampling.

During the spring and summer it is cheaper for the sheep owner to hire an extra herder for his ewe bands than it is to have a number of the ewes and lambs injured by dogs. The wrong kind of or too persistent herding at this period is likely to result in an inferior clip of wool; improper herding is also the main reason for an excessive amount of sand and dirt in the fleece. Small, thin lambs are likely to be the aftermath of herding with dogs, particularly poorly trained dogs.

Selecting Bedding Ground. — At some convenient time during the day the herder selects the bedding ground for the night. He then brings his bed and other equipment, including salt for the sheep, provided he salts on the bedding ground, to the place selected.

The herder should choose the best site available for the bedding ground. It should be open but need not be clear of timber. Ground where there is much brush, fallen timber, or other obstructions should never be selected as a site when a more suitable area is available. The space chosen should be larger than is actually required. A site 200 feet in diameter is large enough but a larger space is not objectionable. By selecting a site devoid of brush and fallen timber, better protection against the attacks of predatory animals can be given. On an area free from snags and other entanglements, the sheep, when attacked, can move about without being crowded. This gives the band a greater sense of security and makes it easier for the lambs to locate the ewes.



FIG. 32. — BEDDING DOWN FOR THE NIGHT.

The spur is only slightly higher than the surrounding area and practically free from timber, brush, and logs — factors to be considered in selecting a bedding ground.

Selection of a bed ground on the open range is easier, the chief requirement being ground that is higher (preferably a spur or ridge) than the surrounding country. Here the sheep will rest contentedly, whereas if bedded in a canyon or swale, they will be restless and instinctively move to higher grounds during the night (Fig. 32).

On most timbered ranges there are small open places or parks which should be utilized for bedding ground. The location of these should be known to the herder in order that the day's grazing can be planned so that it will result in the band being near one of these spaces by evening. On rugged range care must be exercised not to select the bedding camp near cliffs or ravines, as the sheep might be injured if they wandered in the darkness.

Sheep are more liable to attack from predatory animals on a brush range than elsewhere, hence open sites are preferable. Unless such a site is selected, the flock will be uneasy and restless.

Assembling Sheep for the Night. — When it is time to round up the sheep for the night, the herder passes around the outermost tracks made by the band during the day. The tracks indicate the course taken by animals which have strayed and they usually can be traced easily and turned toward the main herd. Late in the afternoon the herder slowly gets his sheep into a loose band headed toward the bedding ground. He should whistle or shout at this time to make sure that no sheep are missing. This brings them together.

By five or six o'clock the band should be near the place where it is to spend the night. Here the sheep are allowed to graze openly until they settle down for the night. At this time the herder can best determine if his band is intact. The conclusion he makes will be based on the flock's general contentment and appearance and the presence of certain easily recognized individuals. If none of the "counters" or "spotters," consisting of black, belled, and odd-looking individuals, are missing, the herder is reasonably safe in concluding that no sheep have strayed from the band. There should ordinarily be from 25 to 40 "markers" in a band. If the herder finds that one of these markers is absent he may well conclude that several sheep are missing. The spots most likely for these strays to be lingering in must then be searched and the wanderers brought back into the fold before they are scattered or killed by predatory animals. If the herder, after a diligent search, fails to locate the lost sheep, the camp tender continues with the task of finding and bringing in the strayed members.

One-night Bedding, Blanket, or Burro System. — Sheep herders in the early days, when there were vast stretches of unsettled plain and mountain country, usually established themselves on the same areas year after year, and all the herders camped in the same place each night and separated their animals each morning. This method has been followed since Biblical days.

Although the banding together of herds and herders at night was a necessary means of protection in the frontier days, many progressive sheep owners have adopted the use of a more economical, although less homelike plan, known as the one-night bedding, or the blanket or burro system of herding.

When the National Forests were opened to sheep grazing, the close-herding method was used by sheepmen. Observation soon proved that in many instances the range, the watershed, and the young timber were being seriously injured by close herding. Believing that sheep could be grazed on these vast and desirable forage areas without permanent injury to the vegetation, if the right methods were applied, the U. S. Forest Service undertook a series of sheep-pasture experiments in several localities and under various conditions.¹

These pasture experiments show that only two-thirds as much range is required for sheep that spend only one or two nights on a bedding ground as is required when one location is used for bedding the band many nights in succession. Moreover, the sheep and lambs make larger gains. From this experiment a system was developed that had as its main points (1) quiet, open herding, (2) the minimum use, if not the elimination, of dogs, except for the protection of the band at night from predatory animals, (3) the use of a new bedding ground each night, and (4) rotation grazing of the range. This experiment extended over a four-year period, and since 1910 increasing numbers of wool growers who use the National Forests have been grazing their bands according to plans worked out by the Forest Service.

When the bedding-out, or one-night camp system was first

¹ Jardine, James T., "The Pasturage System of Handling Range Sheep." U. S. Forest Service Cir. 178, 1910.

practiced, many sheep owners and herders feared that losses from predatory animals would be greater than they had been formerly. This has not proved to be the case. As coyotes are somewhat suspicious of new surroundings, they are less apt to attack sheep on a one-night bedding ground than they are on one that has been used several nights in succession. Then, too, coyote attacks are most frequently made in the late evening and early morning when the sheep are trailing in and out of camp. Under the one-night bedding-ground system, the herder is always near the sheep at these critical periods. With this system, also, the lambs are ready for market at an earlier date than they are when other systems are followed. To make rapid gains, a lamb, like a child, should have plenty of milk, rest, and sleep. Under the old system of excessive use of a bedding ground, the lambs were jammed and dogged along; consequently they were restless and often separated from their mothers.

With the adoption of the blanket or burro system, the lambs feed or rest as they are inclined, and grow rapidly. They come off the range cleaner, they are easier to handle, there are fewer cripples, and they are in a condition of flesh to command top range-lamb prices.

Leaving the Bed Ground. — As pointed out, the sheep should be allowed to start grazing in the morning as soon as they wish to. They will spread out gradually and, as long as they graze in the general direction desired by the herder, they should be left alone. The leaders should always be turned or checked quietly when necessary and without disturbing the rest of the band. The herder should move quietly and keep out of view whenever possible. His work at this hour is to keep a sharp lookout for predatory animals and guide the band in a general direction toward the place where they are to feed and rest for the day.

"Shading Up" in Hot Weather. — When sheep settle down after their morning's grazing, which ends usually about nine o'clock, the herder should not disturb them. During the warm part of the day the flock will remain in a shady place, similar to that shown in Fig. 33, grazing at times, but not moving about much.

The herder need give little or no attention to the flock when the sheep are resting; hence, he can attend to various camp duties and cook at his supply camp. Two of his three meals are usually eaten at this camp, one after he has guided the sheep to their feeding place in the morning, and the other about four o'clock in the afternoon. It is sometimes necessary to spend a little time during the day in looking after the band to make sure that it is not mixing with other bands, straying, or trespassing.

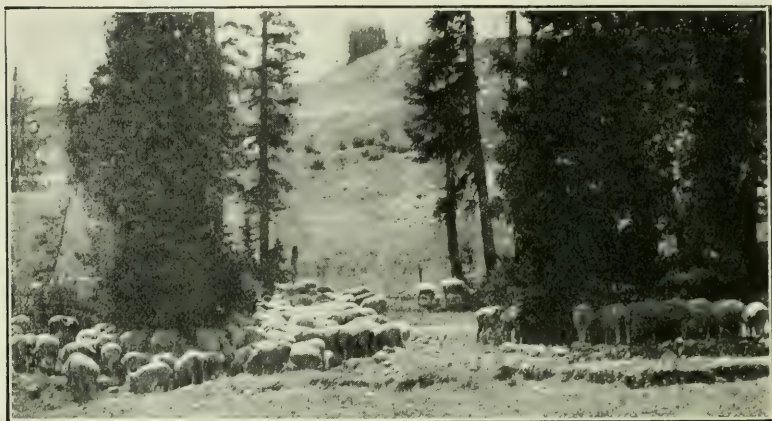


FIG. 33. — "SHADING UP" AFTER THE MORNING'S MEAL.

Under the bedding-out system of herding the sheep seek shade early in the day for they crop vigorously during the cool early morning.

The one-night bedding system seems to be quite as adaptable to open range country and to lands of high grazing capacity as to areas where the forage is sparse. The fact that the essential camp equipment is carried on the back of a burro, trained to trail with the sheep, reduces the amount of work and allows the herder to spend as much time with the sheep as he finds necessary.

Herding to Avoid Losses from Poisonous Plants. — Some losses, especially among the lambs, are likely to occur on a poison-infested range in spite of the herding methods adopted. If the losses are not to be serious, the sheep must be handled carefully. At present the losses among sheep from poisonous plants in many extensive forage communities are probably equal to those from

all other causes combined. The plants that cause most of the poisoning² are fairly well known but their occurrence is sometimes so frequent and the distribution so widespread that it is not practicable to attempt to exterminate them. The adoption of open herding, the use of the burro system, ample good feed, and special care along the sheep driveways, all help in controlling losses from poisonous plants.

Watering the Band. — The period that sheep may be away from water depends chiefly on the weather and the character of the forage.

In cool weather, on succulent vegetation, water once in three or four days is sufficient for sheep. If the weather is hot and dry and the feed is no longer succulent, the band will do best if watered daily and kept where there is ample shade and good forage. Where a large proportion of the range forage dries up early in the season and the supply of stock water becomes scarce, the few areas that have an ample supply of water should be reserved for the dry, hot periods. The coming of cool weather and storms late in the summer and fall usually makes it unnecessary to water oftener than once in three or four days. At such times the range that was too dry to graze earlier in the summer may be fully utilized.

Where water is abundant the sheep should be allowed to choose for themselves whether or not they will drink. If water is near, the keen sense of the animals will make them aware of this fact and if they need water they will seek it. Driving them to water daily is unnecessary. Where water is scarce, and necessary because of the forage, the herder should plan so that a minimum of trailing will be necessary to and from the watering places. The ranges that are too dry to graze during the warm summer period should be grazed either during rainy weather or when the band has just come from water. As long as the sheep appear content on a dry range they should be allowed to remain

² The subject of livestock poisoning is fully discussed and the plants well illustrated in the author's book, "Range and Pasture Management," John Wiley & Sons, Inc., New York, 1924.

on dry feed. When they are thirsty they become uneasy and the lambs fail to take on weight as they should.

The band should be directed toward the water so as to reach it just as the warmest part of the day approaches, and they should be allowed to graze toward the watering place in loose formation — never in a compact mass.

Sheep, like other animals, prefer clean, fresh water, but if such a supply is not obtainable and they are thirsty they will drink any kind. If the watering place consists of a small stream, it is best to approach it from the lower end, permitting the sheep to work up the stream gradually. In this way the stream will remain free from dirt and litter during most of the time that the sheep are drinking. When feasible, remove any floating *débris* from the top of the stream before watering the sheep.

The sheep should be allowed to remain at the watering place during the warm part of the day if the range is some distance away. The drift back to the feeding area, however, should not be made so late that it will be necessary to rush the band in order to reach the range and bedding ground before dark.

Grazing Sheep without Water. — On many western ranges there are areas which contain excellent forage for sheep but no available supply of water.

In 1912 and again in 1913, on the Uinta Forest in central Utah, two bands, each containing a total of 1700 head of ewes and lambs, had no water whatsoever for 100 days other than that which they obtained from the succulent feed and the heavy dews. The period of grazing on this area was from June 10 to September 20.³ In the autumn the lambs of these bands averaged fully as much in weight as lambs of the same breed and grade which had been raised on similar ranges where the sheep had access to abundant pure water throughout the season. The test proved, however, that only those ranges having abundant succulent vegetation of broad-leaved herbs can be grazed with good results without drinking water. Moreover, the accumula-

³ Jardine, J. T., "Grazing Sheep on Range without Water." *The Natl. Wool Grower*, Vol. 5, No. 9, pp. 7-10, Sept., 1915.

tion of dew on the vegetation in the early morning tended to maintain the succulence of the forage.

Although the experiment made possible the use of range never before grazed by sheep, any attempt to use range devoid of stock watering places should be entered into cautiously and on an experimental basis. Neither browse (chaparral) nor a pure grass cover may be expected to be grazed successfully without a supply of stock water. To graze sheep with impunity on poorly watered areas, the open system of handling the band should be followed, preferably the one-night camp plan should be used, and all hurrying and unnecessary driving must be avoided.

Salt and Salting. — Because there is generally not enough of that all-important mineral, chlorine, contained in the forage or in the soil, sheep must be fed salt (sodium chloride). The character of the forage upon which the sheep are grazing determines largely the amount of salt that they need. When the feed is dry, less salt is required than when the forage is succulent. Plenty of salt makes the sheep easier to herd, they are more content, and they are healthier. There is no danger of bad results from feeding all the salt the band will clean up if it is accustomed to this all-important "medicine."

A mature sheep requires about $1\frac{1}{2}$ pounds of salt during the summer grazing season of about 100 days, when the forage is succulent. This amounts to approximately $\frac{1}{3}$ pound for each mature sheep a month. One hundred pounds of salt of a desirable kind, fed every five days to a band of 1200 ewes and their lambs, is ample.

The salt should be fed in a form that will not injure the mouths or teeth of the sheep; also, it should be of a kind that will enable them to eat the amount they desire in a short time. Rock salt is not suitable because it takes sheep too long to obtain the amount they desire. Neither is block salt the best, for it too must be dissolved by licking with the tongue. The time spent in getting salt could be better employed in resting or feeding. The band stays longer on the bed grounds in the morning when block or rock salt is fed, as their appetite for salt has not been satisfied. Also, they are more restless at night. Another reason why rock

or compressed salt is not satisfactory is because the larger sheep crowd the lambs away from the chunks. Few get as much salt as they desire, and many eat quantities of dirt and clay to obtain a little salt. This packs into a hard mass in the stomach and sometimes causes death. The hardness of rock salt often results in broken teeth, for the sheep will frequently gnaw the chunks instead of licking them. Animals with broken teeth must be disposed of quickly as sheep with poor teeth can not withstand the rigors of the range. Because it is easily transported and has all the qualities desirable for feeding purposes, ordinary coarse crystal rock salt, or unrefined salt, is best. Fine table or dairy salt is wasteful for range use.

On some ranges in Australia, special salt "licks" are prepared for sheep that are not in the best of health. Two formulas are commonly used, as follows:

<i>Iron-lime Lick</i>		<i>Ginger-iron Lick</i>	
Crushed salt.....	112 lbs.	Crushed salt.....	114 lbs.
Slaked lime.....	6 "	Slaked lime.....	4 "
Sulphate of iron (copperas).....	6 "	Sulphate of iron (copperas).....	14 "
Turpentine.....	$\frac{1}{2}$ pt.	Flowers of sulphur....	4 "
		Ginger.....	2 "

Under certain conditions when the ewes seem to require a stimulant, or when during the period of breeding the œstrual cycle (heat period) is delayed or absent, the ginger-iron lick has been advocated. The iron-lime lick is used more commonly as a general tonic and disease preventive.

Sheep should be fed salt at least every seven days or the condition and management of the flock will be impaired. Some herders find it more satisfactory to feed the band 20 to 30 pounds of salt each evening on the bedding ground. When salt is not given for long periods, also when it is fed at irregular intervals, the digestion of the sheep is upset and scouring sometimes results.

There are two popular ways of feeding coarse crystal salt. One method is to place it in portable troughs of wood or canvas. The criticism that is sometimes made regarding this method is

that all the sheep do not have an opportunity to get salt every night. As a matter of fact, few sheep care for salt every day and there is usually room around the troughs for all the sheep that wish salt.

On the range most of the salt is fed on or near the bedding ground. When fed away from the bedding ground, double handfuls are placed in convenient spots at frequent intervals. Any place that is comparatively free from loose dirt or gravel is suitable; bunches of sod and flat, clean rocks are satisfactory. A grassy turf of the meadow type is a good place for salting.

Salt is important in holding in check losses from poisonous plants. Losses from all causes, poisonous plants included, are considerably reduced when the animals are kept in good condition.

QUESTIONS

1. Why are more sheep raised in the West than in the East?
2. Outline the yearly routine usually followed in handling a band of sheep in the West.
3. (a) What range state markets the largest percentage of lambs from its bands? The smallest percentage? (b) What is the average percentage of lambs marketed in western states?
4. (a) What are the duties of the camp tender? (b) Which is the more responsible, the work of the herder or that of the camp tender? Why?
5. (a) What is the proper size of a band of ewes and their lambs, in the West? Of wethers? (b) Discuss fully the objections to running large bands of ewes and lambs.
6. (a) Discuss fully the advantages or disadvantages of quiet handling and open herding of sheep. (b) Outline the effect of the use of dogs on the sheep and on the range.
7. Describe an ideal bedding ground for sheep.
8. How early in the morning should the band be allowed to leave the bedding ground?
9. What are the duties of the herder in the handling of the sheep during the day?
10. How is the band assembled at night?
11. (a) Discuss fully the use and advantages, if any, of the one-night bedding ground or "burro system" (1) to the sheep and (2) to the range. (b) How and under what conditions was the one-night bedding system developed?
12. (a) How long should the herder permit the sheep to "shade up" on

warm summer days? (b) What time in the morning do sheep usually seek shade?

13. How should sheep be herded to control as far as possible losses from poisonous plants?

14. (a) How often should sheep be watered in the summer? (b) Can sheep be grazed on range without water? If so, how long and with what results? (c) At what time of the day is it best for the band to reach the water and how long should it remain there?

15. (a) How much salt is required for a sheep per month or for the summer grazing season? (b) How much salt should be fed and with what frequency? (c) What kind of salt should be fed? Why?

NOTE. — The bibliography for this chapter is placed at the end of Chapter IX (page 148).

CHAPTER VIII

RAISING SHEEP ON THE RANGE (*Continued*): **BREEDING, LAMBING, AND DOCKING**

The preceding chapter has discussed sheep raising in the West from the time that the band is admitted to the summer range, until inclement autumn weather forces the sheep to the winter grazing grounds. The present chapter is concerned with the details of the management of the band from the beginning of the breeding season in the autumn, through the winter, and from the time of the all-important lambing period, to the marketing of the lambs.

BREEDING

The Breeding Season. — On the range ordinarily breeding is planned to take place between the first of October and the first of December. In regions where the spring is late the mating time is postponed accordingly. Where the so-called "hot-house" or early lambs are produced, as in California and various parts of the South, the rams are usually admitted to the ewe herd in June, July, or August. Five months is the gestation period for ewes.

Condition of Ewes. — At breeding time the ewes should be gaining rather than losing flesh. If the ewes are at a standstill or going back, the chances are more than even that they will not all breed within five or six weeks after the rams have been turned into the herd, and therefore the lambing season will be too long. Lambs of uneven age and size are not of uniform finish and hence do not command top prices. The most uniform lamb crop is obtained where the ewes are placed on a good pasture of succulent forage for about two weeks before the rams are turned in with them.

Condition of the Ram. — Since the breeding season is comparatively short but strenuous for the ram, he should be given

special care and treatment. Where the ewes are driven many miles to the winter range prior to breeding, it is best to ship the rams to the band and ship them back after the period of service. Moreover, many sheepmen during the breeding season feed the rams all the grain they will take twice a day. Even where handled carefully, the active breeding service of a western range ram is seldom more than four years.

During the non-breeding season, and especially in the summer, a sheep-raising community usually makes up a "buck" herd and grazes a band of several hundred rams on the range. No supplemental feeding is done during this period.

Number of Ewes to Ram. — Under ordinary conditions one ram is satisfactory for the breeding of 50 ewes, but much depends on his age, vigor, breed, and the methods of handling. If young, a ram will serve in a couple of weeks 35 to 50 ewes, when allowed to run with them all the time, and from 50 to 75 ewes if allowed to be with them only part of each day. There should always be enough rams in the band to insure the dropping of the lambs over a period not to exceed five weeks.

Some good managers of the breeding band will turn into the herd a few strong bucks towards the end of the breeding season in order that they may find the ewes that have failed to mate with the bucks that have been in the herd throughout the period. Some wool growers are strong advocates of this plan.

Shearing. — The shearing season comes at different times in different parts of the country, starting early in the spring in the southern states and ending in June or July in the North. Generally the wool is removed before lambing. The subject of shearing and marketing the wool is fully discussed in Chapter X.

Dipping. — Shortly after shearing the band should be dipped to kill parasites and to check skin diseases. The dipping should not be done too hurriedly, nor can the dipping solution be weaker than is recommended to be used if worthwhile results are to be obtained. A discussion of dips and of the dipping operation is given in Chapter XI.

LAMBING

Lambing Period. — This important and busy time obviously comes earlier in the South and Southwest than in the North. It also varies with local conditions and with the amount of feed which the sheep owner has. It is desirable to have the lambs dropped as early in the spring as the feed and the climate will permit, but since green forage is essential to a plentiful milk supply, the lambs should not come before the growth of forage starts. In regions where severe late storms occur more or less commonly, unless good shelter for the lambing band has been provided, the breeding season should be delayed to avoid heavy losses of lambs.

April and May are the two months in the Northwest when most of the lambs are dropped. January, February, and March are the months for lambing in the Southwest. In the milder foothills of California the lambs usually come to correspond with the period of forage growth.

Hothouse Lambs. — Lambs born so early in the winter as to be marketed mainly between March and May are spoken of as "hothouse" lambs. To raise hothouse lambs successfully requires, first of all, a mild climate so that an abundance of green winter forage is produced. Hothouse lambs are raised in various parts of the South, but at present the industry is probably most extensively developed in the interior valleys of California. In the farming centers of the Imperial, San Joaquin, and Sacramento valleys of California, the business has developed some very large operators, and thousands of early milk lambs are produced annually.

In California and in certain other localities, the wool growers secure their crop of lambs from bands purchased or managed essentially in the following ways: (1) Maintaining year after year high-grade breeding ewes of a breed which is popular locally. These ewes are mated with rams of the same breed, and the aged ewes are replaced with the best ewe lambs. (2) Buying each year aged ewes, pasturing them on superior forage, and selling both the ewes and their lambs in the prime condition

possible. (3) Buying an entire band of young ewes about every five years to replace the older band as its breeding efficiency begins to decline. These young ewes are bred to secure the maximum number of lambs, all of which are marketed. (4) Buying a sufficient number of young ewes every year or two to maintain a vigorous breeding band.

In the Imperial Valley the business generally is somewhat more speculative than elsewhere in California, as a large proportion of the operators buy each spring, for fall delivery, light Mexican ewes which are bred early in the summer. Many who operate on this basis have realized more for the lambs than the original cost of the ewes, but many others have suffered severe financial losses. The purchase each year of bred ewes is too speculative for most operators.

Regardless of the stability of the plan of operation, the ewes and lambs are grazed upon the native pastures or (in the Imperial Valley and certain sections of the Southwest) upon alfalfa fields, both of which grow luxuriantly in the winter. In good seasons, alfalfa, bur clover, wild oats, and other such natural forage is so nutritious that the lambs can not always be induced to supplement the ration with grain. The gains are rapid and average nearly $\frac{1}{2}$ pound a day for the first five months. The lambs are marketed when they weigh between 60 and 70 pounds. The sheep never leave the floor of the valley but are more or less closeherded at all times. Although the summers are hot, the ewes and rams appear vigorous and healthy, but they may not breed quite as well as ewes grazed on the cool, elevated summer range. In the milder climates, especially where the summers are hot, the sheep are shorn twice a year, usually in March and August. In the valleys of California two shearings annually are almost a necessity because of the annoyance of seed getting in the wool and because of the hot weather. The ewes sheared twice a year in the California valleys are generally in good physical condition and breed better than ewes shorn only once a year and handled under the same trying summer conditions.

During the greater part of the summer and fall the ewes are grazed upon wheat, rice, and other stubble lands where bur

clover, alfalfa, and other delicacies grow in profusion. Hot-house lamb raising is developing into one of the most important specialties of California. As the methods of operating are improved and the animals safeguarded against the risk of sparse winter forage (for this is one of the chief handicaps) early-lamb raising in California is sure to expand.

Lambing Grounds. — The lambing grounds should be located near ample green feed and plenty of water. These conditions are necessary in order to start the ewes to suckling well and because many animals must be kept on a comparatively small area for a period of from five to seven weeks.

For late lambing the mistake is sometimes made of locating the band at so high an elevation that storms occur frequently. It is a good practice, where possible, to select a lambing range at low elevation. A lambing range should have natural protection from storms, cold winds, and an appreciable air drainage, suitable sites being in small coves, basins, and protected pockets in canyons. Such areas are useful also in keeping the "drop band," which is here defined as those ewes of the band that are dropping lambs or are expected to drop their lambs in a day or two, separated from the rest of the sheep during the early part of the lambing period.

Lambing Methods. — Whether the broadcast drop-band method, the shed and pasture method, or the pasture method of lambing without sheds, is used, the results desired in all flocks are the same — a large percentage of healthy lambs born easily and owned by their mothers.

Although it is a relic of the old days of free range, the open-range system of lambing still has its adherents in all parts of the West. There is some excuse for the use of this system in the southern section as there is less danger of storms and the weather is milder and less treacherous at the time of lambing than it is farther north. The shed and pasture, or corral and pasture method, as it is sometimes termed, is gradually taking the place of the more primitive practice, even in the Southwest. When a sheepman is almost certain that he can have the same range year after year, he usually finds it profitable to erect permanent lamb-

ing quarters, and this plan is being somewhat more generally followed.

Broadcast Method. — On the open range, lambing differs from that in sheds in that in the latter instance the ewes are brought into corrals by night but are herded on the range during the day. Methods vary in different localities but all are the same in general.



(C. J. Belden.)

FIG. 34. — BROADCAST LAMBING ON THE RANGE.

As the lambs are dropped, they, with their mothers, are assembled in small bunches.

Throughout the lambing period herders look after the band during the hours of darkness as well as by day, and when a lamb is born the ewe and lamb are taken from the band, cared for if necessary, and placed in the "lamb band." The "lamb band" is defined as the ewes that have already lambed, the lambs being sufficiently old and vigorous to follow the ewes about and needing no further detailed attention. In some localities the "drop band" is bedded just outside of the lambing corrals at night but the ewes

and newborn lambs are not disturbed if the birth is normal and the ewe mothers the lamb.

In the morning the rest of the band goes out on the range. The ewes and lambs are placed in a separate band, and if any lambs are not owned, lamb and mother are placed in a lambing pen.

An extra herder follows the so-called "day band" of pregnant ewes, and as soon as the ewes drop their lambs the ewes and lambs are gathered together in bunches of 10 or 20, and these small drop bands are temporarily left behind the procession (Fig. 34). A flag is erected at the spot so that later they may be easily located, but they are usually not disturbed during the first day. There is little danger of their straying during that period, but even so, a herder or boy occasionally looks after them. In the evening the small drop bands of ewes and lambs are gathered together and added to the larger lamb band. For stormy weather in some localities, a lambing blanket is used to cover the lambs born on the open range.

Shed and Pasture Method. — Together with many other modern methods on the range has come the use of a lambing shed or tent. The methods employed are the same in either instance.

The ewes under this system are kept in a corral adjoining the shed or tent, or taken a short distance out on the range during the day. As soon as a ewe drops a lamb she and the lamb are placed in one of the pens in the shed. There they are kept until plenty of milk is produced for the lamb and until both ewe and lamb are doing well.

Where the country is level, a lambing wagon is sometimes used to follow the day band as it grazes. This wagon is equipped with enough small pens to accommodate twenty ewes and their lambs. As soon as the ewe drops her lamb, she and her lamb are placed in one of the pens and the wagon continues to follow the band. When the pens in the wagon are filled it is driven to the shed or tent.

Details of Shed and Pasture Lambing. — For purposes of testing the plan of lambing in sheds and pastures, and of developing a suitable lambing plant, experimental equipment was built

in the Cochetopa National Forest in Colorado. This plant has been copied, with variations, by numerous sheepmen in Colorado and other states, for it immediately proved its worth and practicability. The arrangement of the pastures is illustrated in Fig. 35.

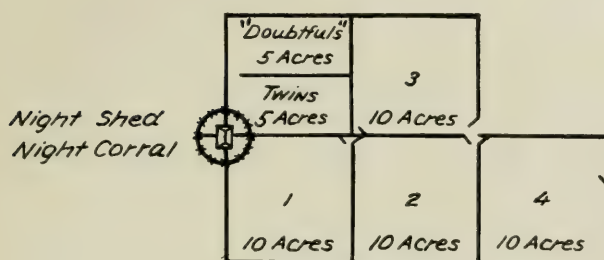
The lambing plant, shown also in the sketch (Fig. 35), will take care of about 1500 ewes, and, among other things, provides a corral in which the band is left each night. The ewes are carefully watched, and if any signs of parturition are shown, the ewe is transferred to the shed, which is a substantial shelter adjoining the corral. Part of the floor space is occupied by some forty small pens. The shed is warmed by a moderate-sized stove located in the center. Each lambing ewe is given a separate pen.

The ewes that have lambed during the night, if they and their lambs are strong, are quietly driven out in the morning into a 10-acre pasture adjoining the shed. Ewes with their lambs have a special pasture, whereas those which are not in good physical condition, or will not own their lambs, are kept in the shed.

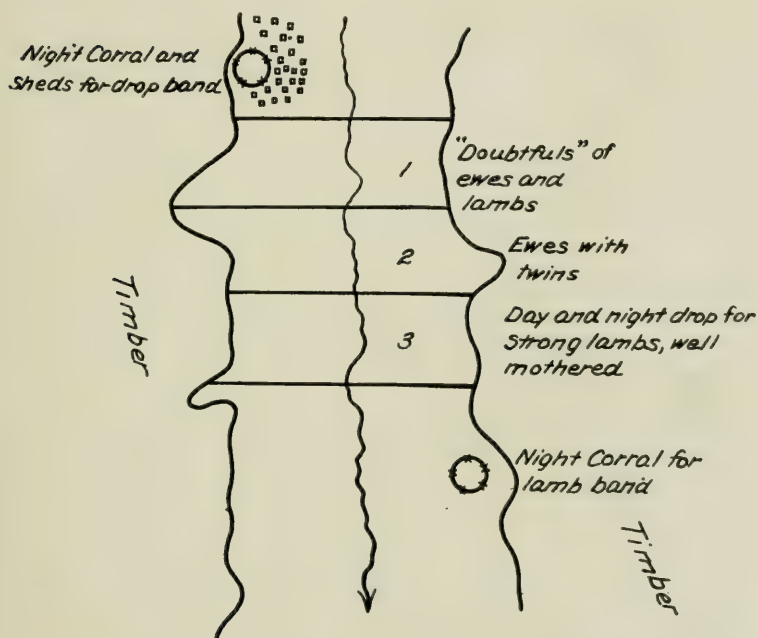
The shed holds a new group of ewes each night during the lambing season, and the preceding group goes out to the small pasture. From the small pasture the strongest lambs and their mothers are moved to a larger pasture. This is continued until all the lambs and ewes have passed through several pastures and are ready for the summer range. In each of the pastures is an open shed into which the band occupying that pasture is herded every night.

During the day the drop band is grazed on the open range adjoining the pasture, with one man in charge and a second one to help in the late afternoon to gather the day's drop. The drop band is taken by night to the pasture adjoining the sheds.

Ordinarily the day drop is placed in a small pen on the range for the first twenty-four hours in order not to disturb the new-born lambs. The next morning the lambs dropped the day before are driven to one of the small pastures, where the strong, well-mothered lambs of the preceding night's drop are found. The lambs needing special attention are placed in a small enclosure adjoining the night shed. Each small pasture is visited



CORRALS AND SHEDS FOR LAMBING
SKETCH-A



EQUIPMENT FOR ONE OF THE
MODIFIED LAMBING PENS
SKETCH-B

(L. H. Douglas.)

FIG. 35. — CORRALS AND SHEDS FOR RANGE LAMBING.

This arrangement, with the area indicated, is ample for handling 1500 ewes.

every day to make sure that all the lambs are being properly mothered.

Toward the close of the lambing season when the drop band consists only of two or three hundred ewes, the ewes are placed in a small pasture or divided into two bands and left to lamb without special attention.

Pasture Lambing without Sheds. — Pasture lambing in some localities has become a popular method, particularly with wool growers who have only a few hundred head of sheep. In California, pasture lambing without sheds is the prevailing method. A large pasture is enclosed with woven-wire fence of good height and, if timber is available, with subdivisions of rails. Such pastures are proof against many kinds of predatory animals. Each morning the herder removes from the drop-band pasture all the lambs that have been born during the night, and their mothers. The ewes with single lambs are placed in one small pasture, while those ewes that need special attention, or those with twins, are placed in another area. The advocates of this system claim that the lamb crop is larger and better when handled by this method than when open-range lambing methods are used. Incidentally, the cost of the lambing plant is less than when sheds are erected.

The ewes in the fenced pastures are not worried or often frightened by wild animals as they may be on the unfenced range; but the weakness of this system, like that of the broadcast system, is that no provision is made for stormy weather. Losses in severe weather are lighter where the pasture method without sheds is used than where the drop-band method is employed, but nevertheless they may be serious.

The pasture system is also used with larger bands by herding the ewes out on the open range during the day, and making their bed grounds just outside the fenced pastures by night. When three pastures are used, the ewes and lambs, as soon as the lambs are dropped, are removed from the main band on the unfenced range and placed in a separate pasture. When there are about 250 ewes and their lambs in each of two of the enclosures, these sheep are combined and placed in a third pasture. In

the meantime the more recently dropped lambs and their mothers are placed in the first two pastures. By the time the second band of 500 ewes and their lambs are ready for the third pasture, the first ones are ready to go on the nearby open range with a herder. These bands are kept separate until all the animals are strong and doing well, then they are combined into regular bands numbering about 1200 ewes and their lambs.

Portable Corrals. — One variation of the pasture lambing system is the "corral" method. A temporary circular corral, from 100 to 150 feet in diameter, is built of logs, woven wire, or canvas, on the lambing range. The corral is divided into four parts by fences running at right angles with each other. Gates at the center lead from one quadrant to another. This corral is used only at night. The drop band occupies one section, the lamb band another, the twins of the day drop a third section, and the single lambs of the day drop the fourth.

The more active and older lambs and their mothers of the drop band are turned out early in the morning, but the lambs that were dropped during the previous twenty-four hours, and their mothers, are held in the drop-band pasture so that they can be looked over carefully and cared for according to their individual needs. After this they are sent to the lamb band or to the hospital band. While this system is much better than open-range lambing, it does not give the weak lambs as much of a chance as they sometimes need.

Cost of Lambing Sheds and Pastures. — The cost of erecting permanent lambing sheds and pastures naturally varies greatly according to the different conditions and localities. The experimental plant erected on the Cochetopa National Forest, which is large enough to care for 1500 ewes and their lambs, cost about \$1700. This amount, for many reasons, is larger than would be required by a private owner to erect a plant of the same size. On the Cochetopa Forest about 50 acres were fenced. The fence consisted of a barbed wire lying on the surface of the ground, a 34-inch woven lawn fence 4 inches above the barbed wire, and on top two barbed wires placed 6 inches apart and 6 inches above the woven wire. This construction practically makes a coyote-

and bear-proof enclosure. Including gates, the total cost of the fence was \$1134. About \$500 was spent for sheds, pens, and other improvements. Ordinarily, \$1000 spent in shed and pasture construction will build a plant that will satisfactorily care for 1000 ewes and their lambs. The cost varies widely according to the locality.

Regarding savings due to the use of a plant such as that described, eight years of records show that an average of 91 per cent of the lambs born each year within the Cochetopa plant were raised, whereas on the outside not more than 85 per cent of the lambs were saved. By the shed and pasture method only two men are required to care for the band, while bands of similar size on the open range require the services of four men, in addition to a cook, and from one to three boys. This makes an appreciable labor saving in favor of the pasture lambing. It was found that the saving in lambs paid for the plant in six years. Besides this, the ewes and lambs handled inside the fence were in much better condition, the lambs making a faster growth, and the ewes showing fewer effects of the lambing ordeal.

Rate of Lambing. — During the second and third week of the lambing period the rate of lambing is usually at its height. At this time the lambing camp is a busy place with seldom enough trained men for the work. Although sheepmen more and more have come to realize that saving a large percentage of lambs is dependent on having plenty of trained laborers at the lambing camp, there is seldom enough good help, owing to the difficulty of obtaining experienced labor.

Care of Lambs. — The range sheep owner of the past did not expect to save more than about 80 per cent of the lambs born in his band, but the sheep owner of today, by exercising greater care, is increasing this percentage. Much care and skill are required to procure a high percentage of lambs, but, at the present price of lambs and wool, care is justified.

Lambing sheds and pastures, to serve their best purpose, should be located in as sheltered a place as possible, but even then the lambs that arrive during inclement weather need extra care or many will be lost. The lamb blanket is used in the sheds

as well as on the range. The blanket, however, can not always be used successfully as it is likely to frighten the young ewe away from her offspring.

Many methods are in use to induce the ewe that has lost her lamb to mother an orphan lamb or one of twins. The skin of the ewe's own dead lamb wrapped around the body of the to-be-adopted lamb, or some of her milk rubbed on the lamb's head and rump, will usually induce her to own the lamb. If, however, the ewe's lamb has been killed by a wild animal the pelt can not be used for the purpose indicated. Then the ewe and her new lamb are placed in a small box-like compartment or "jail" where the ewe can not get away from the lamb. Ordinarily, under these circumstances, she will own the lamb within half a day or a day. Sometimes if the tail of the lamb which is to be adopted is pulled through the mouth of the ewe she will almost immediately own the young "intruder."

To decrease the death rate among newly-born lambs, it is necessary that quiet, careful attention be given to both the ewe and the lamb as soon as the lamb is dropped. Someone should see to it that the ewe and the lamb are doing well and that the lamb is properly mothered and is drawing milk. The ewes with strong lambs should be kept in small bunches during the first ten days, and special attention should be given to the ewes that refuse to mother their lambs, also to ewes that have been given orphan lambs, and to ewes with twins.

DOCKING, CASTRATING, AND EARMARKING

When the lambs are ten days or two weeks old they should be docked, and the male lambs castrated. Docking, when well done, adds to the appearance and cleanliness of the lamb and increases its sale value.

There are many docking methods in use, but the manipulation should be such that one inch of the tail stump is left whatever method is employed. For purposes of breeding and for cleanliness, the tails of ewe lambs are often docked shorter than those of wether lambs. A sharp knife minimizes the pain, but there

is more danger of excessive loss of blood than with the hot searing iron. If the iron becomes too hot, however, the wound is usually slow in healing. The skin should be pushed up before the operation so that it will afterwards cover the wound, and a good disinfectant should be applied immediately after the operation.

When the male lambs are caught for docking they may well be castrated at the same time. Hands and shears or knife should be disinfected. The lower third of the scrotum is cut off in this operation and the testicles removed by pulling them out. Some stockmen prefer to draw the testicles with the teeth. This method has the advantage of much greater speed than any other and causes a minimum number of infections. Castration should be delayed unless both testicles can be felt, which is usually at the age of ten to twenty days. It is well to apply lard and turpentine or some other disinfectant after castration.

If the lambs are to be earmarked, this is done when the tails are docked. The fire brand on the nose was used commonly in former days when sheep stealing was not unusual. Some sheep owners still use the earmark in addition to the body brand, but such a mark requires considerable time to apply and is not readily seen. Ear labels are used to keep records of registered sheep. For large numbers of sheep, earmarks, such as over-and-under-bit, right crop, and left crop are the most practical methods of marking.

In order that the sheep and lambs may be distinguished from those of other growers, the sheep after shearing should be branded or marked with a branding fluid. If common paint is used, as it too often is, it is impossible for the manufacturer to remove it from the fleece. Branding fluids can be scoured out of the wool by ordinary methods. When branding fluids are used the band must be rebranded every five or six months (Fig. 36).

Each company or individual owner has a distinguishing brand, and this is recorded in the Office of the State Brand Inspector and belongs exclusively to the "outfit" to which it is assigned. The lambs are branded when their tails are docked.



(C. J. Belden.)

FIG. 36.—THE MARK OF IDENTIFICATION ON THE RANGE.

A branding material should be used which will not injure the wool.

WINTER RANGE HUSBANDRY

On Winter Range. — By late September or in October most of the sheep are brought out of the mountains, even if feed is abundant, for the weather is usually hazardous. The wise sheep owner or herder leaves the high range before the snow is deep, rather than run the risk of having his band caught by heavy storms. The bands are driven to the lower hills and to the plains or desert. A typical desert range is shown in Fig. 37. On such

a range the snowfall is light as compared with that in the mountains. On the desert range, snow is a necessity as it may furnish the only source of water for stock.



FIG. 37. — WINTER (DESERT) RANGE.

Snow must often be relied upon as a source of water for the band.

Winter Losses. — Not many years ago the winter season was dreaded by owners of both sheep and cattle because of the heavy losses incurred. On the northern ranges the winter losses in sheep aggregated from 7 to 10 per cent, and not infrequently much more. In some localities, even now, hundreds of sheep are lost each winter because of lack of feed and some sort of shelter. The most progressive and successful sheep breeders guard against these losses by providing a cache of concentrated feed here and there.

Supplemental Feeding on Range. — Until comparatively recently the feeding of corn, cottonseed cake, or hay, was the exception. When hard winters came, the sheepman, who must rely upon bleak winter range, expected to stand heavy losses. Today, a man located on a northern range would be thought foolhardy if he made no provision to shelter his sheep against heavy storms or failed to provide feed to sustain the band during the coldest months.

A successful sheepman in northern Idaho, who for fifteen years has grazed his bands on the winter range, until 1917 had taken

winter losses such as are sure to occur in the absence of supplemental feeding. These losses averaged 8 per cent during the many years when no feeding was attempted. Under the system which he now uses, of feeding cottonseed cake, the losses are not more than $2\frac{1}{2}$ per cent. The cottonseed cake is of nut size, or screened nut cake.

The feeding of concentrates on the range should begin when the forage becomes sparse or is of inferior quality, and the weather cold. Some start feeding at breeding time and continue through the winter. If cottonseed cake is fed over a long period, $1\frac{1}{2}$ to 2 ounces to a sheep each day is ample. In very cold weather it is safe to feed 3 ounces of cottonseed to a sheep. Corn and other grains are also fed, but they are less satisfactory than cottonseed cake because of their greater bulk. Cottonseed nut may be fed in the morning when the band leaves the bed ground. It may be scattered on the ground in a row about a quarter of a mile long. Grain may be fed in the same way. The concentrates should be transported to the range early in the fall when the weather and roads are good, and stored within a few miles of where the band is to be grazed. Some sheepmen grow their own alfalfa, clover, timothy or other cultivated forage crops for winter feeding, but more buy from neighboring farmers or have the feed shipped in. In Texas, and to a lesser extent in certain other states, some ranchmen have built silos in recent years to store feed for winter use.

Sheepmen in many parts of the West have demonstrated that not only does winter feeding greatly curtail mortality in the bands but it increases appreciably the number of lambs raised and the value of the wool.

Length of Feeding Period. — The severity of the winter and the location of the winter range determine the length of time for the supplementary feeding. In the greater part of Arizona and New Mexico, March is the only month when grain or hay is fed the entire month. During the other winter months supplemental feed is given only in the event of abnormally heavy snowfall. In Idaho and on the more northerly ranges, concentrates are often fed during the entire winter.

QUESTIONS

1. (a) At what seasons are the ewes ordinarily bred on the range? (b) What is the gestation period for ewes?
2. (a) In what condition should the ewes be at breeding time? (b) What should be the condition of the ram? (c) At what age should a ram be used for breeding purposes, and how many ewes should he serve during the regular breeding season?
3. At what time in the season should it be planned to have the lambs dropped?
4. How would you recognize a good lambing ground?
5. (a) Enumerate the different methods of lambing as used in the West. (b) Discuss fully the broadcast lambing method. (c) Discuss the merits of the shed and pasture method of lambing. (d) What is the approximate cost of the construction of lambing sheds and pastures like those considered in this chapter?
6. (a) Discuss fully the care of young lambs. (b) At what age should lambs be docked and castrated?
7. How are sheep marked or branded?
8. At what time in the season are sheep sent to the fall or winter range?
9. (a) What per cent of loss may be expected per annum from range sheep where there is no supplemental feeding? (b) To what extent is the feeding of corn, cottonseed cake, or other such concentrates practicable in the handling of range sheep? (c) How much cottonseed cake may safely be fed with good results to a sheep per day?
10. How long is the supplemental feeding season usually (a) in Arizona and New Mexico? (b) In the northwestern states?

NOTE. — The bibliography for this chapter is placed at the end of Chapter IX (page 148).

CHAPTER IX

RAISING SHEEP ON THE FARM

Because the more valuable public lands are still being taken up by the home-seeker, sheep raising in the range states continues to decline.¹ The adjustments between the western range and the cultivated lands are similar to those which preceded the land settlement in the Middle West. Even now (1928) an occasional pioneer flockmaster can be found who remembers how, after grazing his bands on unfenced and unclaimed lands in Indiana, Illinois, and adjacent states, he drove them to the Chicago market, and bedded them down on land which is now occupied by Chicago skyscrapers.

The curtailment of sheep production on the open range is not peculiar to the United States; between 1910 and 1925 sheep raising on the less valuable lands declined in practically all countries except New Zealand and South Africa. A part of the decline, in the United States at least, can be offset by the use of improved methods in the management of the sheep and the pastures, and possibly, too, by the adoption of improved public land policies. As more of what is now range land comes under the plow, further curtailment of sheep raising in the range states is inevitable.

Place of Sheep on Farms. — Sheep are slowly coming to occupy the rougher lands of the South Atlantic region, the Appalachian area, and the states bordering on the Great Lakes. The belief that sheep raising in these regions will greatly increase in the future is substantiated by the fact that the greater part of these rough lands is given over to the production of luxuriant crops of native and of introduced forage and only a small portion is devoted to raising grain. Successful beef and pork production

¹ The author has aimed to emphasize chiefly the principles with which the farmer is most concerned. Topics that have been covered fully in the chapters on sheep raising on the range are little more than recognized in the present discussion.

requires that a considerable amount of concentrated feeds be produced. The choicest carcasses of mutton and lamb, on the other hand, require a relatively small amount of grain; in fact, the majority of the lambs sold to the butcher are marketed at the time of weaning, hence they have had little or no feed other than the ewes' milk and a small amount of pasture forage.

Another consideration is that sheep raising requires a comparatively small amount of farm labor. No prospective flockman, however, should undertake sheep raising thinking that sheep require no labor or attention, or that they are mere farm scavengers. True, sheep devour a surprisingly large variety of forage and other feed, and save much labor by keeping down undesirable vegetation on the farm; but many a farmer has failed in sheep raising because he neglected his flock. Like other foraging animals, sheep require careful attention and close, intelligent observation. If properly cared for, either a purebred or a grade flock usually proves more profitable than other kinds of farm animals. Moreover, the labor problem on some farms, due to the fact that there is little to do at certain seasons, can be partly solved by having a small farm flock.

Farmers in this country formerly did not give sheep husbandry the attention it deserves, evidently being under the impression that the average farmer with limited acreage, can not compete successfully with the owner of large flocks grazed on western range. That this is erroneous is now somewhat generally acknowledged. While it is doubtless true that a range-fed lamb can be marketed at a lower cost than one raised on a farm, there are other factors besides the cost of rearing to be considered in determining whether a farm flock is profitable.

Building up the Land. — That sheep are valuable in building up impoverished land has been recognized in the European sheep-producing countries — England, Scotland, and Germany — for centuries, but Americans have been slow in realizing this important fact. Sheep droppings contain a larger amount of fertilizing materials than those from any other domestic animal, with one exception. For this and other reasons, placing a few sheep on a run-down pasture is one of the easiest and cheapest

ways, in this day of high cost of fertilizers, to restore depleted lands. Many farms have rough or gullied fields which are unsuitable for cattle and horses, but upon which sheep would thrive admirably. A flock placed on such areas would turn into a paying investment land that is idle and perhaps a total or partial loss.

Besides building up the fertility of the land, sheep are invaluable as weed destroyers, ranking with goats in this work. In most localities nearly all of the troublesome weeds found on hilly lands are eaten by sheep. It can not be expected, however, that a flock will thrive on an exclusive diet of farm weeds, but such vegetation serves well as a part of the sheep's feed. Even where the farm contains no waste land, a few ewes may be kept profitably. They will provide, besides a considerable supply of wholesome meat for the family table, a surplus which can be marketed and a wool clip which will help to increase the farm income.

Handicaps in Sheep Raising. — In many localities the most serious problem which the sheep owner faces in keeping a flock is the sheep-killing dog. This menace has practically ruined the sheep industry in some sections. Where sheep-killing dogs have to be combated the danger may be reduced by having the sheep rest at night in a lot near the farm buildings, as dogs are seldom bold enough to run the flock by day or to molest it when it is near a house or barn. If the dogs are strays they can be shot on sight, but if they belong to a neighbor shooting is likely to result in bitter feelings, unless the owner can be persuaded to do the shooting himself. In neighborhoods where everyone owns a flock, the cur dog problem is usually not very serious, as it is to everyone's interest to curb the activities of the vagrant dog.

Parasites are another handicap to success in raising farm sheep. They can be kept down by rotating pastures and by using annual forage crops. Unchecked, parasites will lower the vitality of the flock and so reduce the profits.

Sheep on Irrigated Farms. — As large quantities of various kinds of forage are grown on irrigated farms, such districts are generally admirably adapted to sheep raising because on most

irrigated farms considerable of the forage grown is wasted unless a few sheep are available to serve as scavengers (Fig. 38).

Forage, cereals, sugar beets, and potatoes are the crops of greatest importance on irrigated farms. A large proportion of the roughages from these crops, either because of the distance to market or because of their character, can be utilized profitably



FIG. 38. — ON IRRIGATED FARMS, SHEEP CONVERT INTO MUTTON AND WOOL, ROUGHAGES THAT WOULD OTHERWISE BE WASTED.

only when converted into animal products on the land. By-products of the sugar beets and cereals may be utilized more or less fully if foraging animals are kept.

Although, in the past, hogs and dairy cattle have been favored by irrigation farmers, the high cost of grain and labor is also bringing sheep into favor in irrigated regions. When sheep are kept, the common practice is to combine sheep raising with some major enterprise, such as hog raising, dairying, orcharding, or the growing of sugar beets. Such combinations work out to good advantage.

Selecting and Establishing the Farm Flock. — The size of the flock is the first step to be determined after the decision to raise sheep has been made. Farm flocks range anywhere in size from a score or so of individuals to several hundred. If the prospec-

tive sheep owner has had no experience with sheep it is best to start with only a few animals. In starting conservatively, heavy financial loss, due to the mistakes which the beginner is apt to make, will be avoided. For the same reason it is argued that the novice may do better to start with grade ewes rather than purebreds. Other authorities contend, however, that the best is none too good for the beginner and that, having fewer animals, he is enabled to buy better individuals.

In favor of starting with a good-sized flock is the fact that it is not easy to market a few lambs and a little wool, and that when the enterprise is of some moment the farmer is likely to give the flock better care than when less money is invested. Also, with the larger number the land can be kept stocked more nearly to its capacity than it can when the start is made with a few sheep. Better use is also made of labor.

Ewes for the farm flock may be secured locally or from a large livestock market where both native and western stock can be bought. In either event uniform stock should be selected or the lambs will be so uneven that they can not be marketed readily or to advantage. Breeding ewes should be thrifty and well grown when bought, for if a strong constitution is lacking they will not be profitable. Good reproductive power is also a highly important attribute in a ewe. If the flock is being kept to produce mutton the ewes must have a good mutton form. If they do not possess this quality the lambs, even from a good sire, will lack form and finish. A quiet disposition is an important characteristic of a good flock mother. Very old or very young ewes should not be selected for the flock; not too old because they are likely to be past their prime, and not very young because they are not sufficiently developed at lambing time and are likely to have trouble during that period. For the beginner, ewes that have had one or two lambs are ideal.

Even though the wool is to be regarded as a side issue, ewes with a good fleece should be selected, as an ample wool covering is the best and most natural protection sheep have against changes in weather; and it will bring in considerable revenue even when wool is low in price.

As for breed, much depends on the region concerned. On level fields with good pasturage one of the heavier breeds is perhaps best. If the pasture is rough and hilly, one of the smaller breeds should be chosen.

The ram is one-half the flock, and a purebred that is a good individual should be procured. The ram should be of a desirable mutton type, for the lambs will resemble him more than they will dams of grade stock. The ideal ram is well grown, active, and vigorous, wide and deep for his length, symmetrical, and with an even covering of flesh on all points of mutton excellence. When the ewe lambs are saved for breeding, the successive rams should be of the same breed in order that a uniform flock may be developed.

It is better to buy the ewes before the ram is bought, as a male can then be selected that is strong in the points in which the ewes are weak. When the flock is small, it is a good plan for a number of small owners to cooperate in buying or renting a ram. Each owner then pays for the service and maintenance of the ram in proportion to the number of ewes he breeds.

Buildings and Equipment. — In making a start with sheep, the farmer need not spend much for buildings and equipment. In latitudes where the winters are long and severe, no elaborate provision for warmth is necessary. What is needed is protection for the sheep from storms and dampness. A straw-thatched shed is often used as a sheep shelter.

It is important that the building which is to be used for housing the sheep be placed on a dry, well-drained site. The building should be well ventilated and cool in summer, but free from drafts (Fig. 39). Also, there should be ample dry and well-sheltered yard space near at hand. In locating and planning the building or shed, convenience in feeding and shepherding must be kept in mind. In the milder sections of the country there is little need for housing, the main requirements being a sufficient number of well-fenced pastures which are large enough to permit shifting the flock at intervals. This helps to prevent disease and parasites from troubling the sheep. When the flock is small, it can be cared for, if desired, in an unused portion of a barn

devoted to other uses; but if there are 100 or more ewes in the band a separate building is better. The space within should be

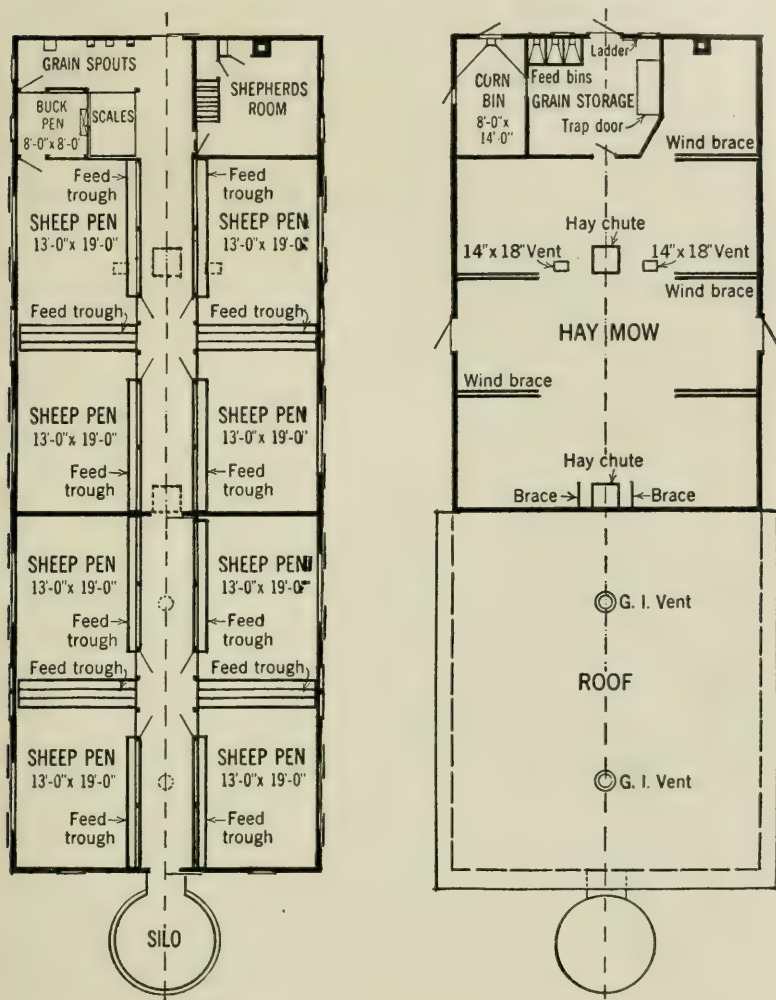


FIG. 39. — FIRST AND SECOND FLOOR PLANS OF A WELL ARRANGED FARM SHEEP BARN.

arranged for convenience, ease in cleaning the pens, and to insure the least disturbance in moving the ewes during the lambing season. Feed racks, grain troughs, and various other

equipment can be made or bought at a small cost. Their construction should aim to reduce the labor of caring for the flock and prevent the waste of feed (Fig. 40).

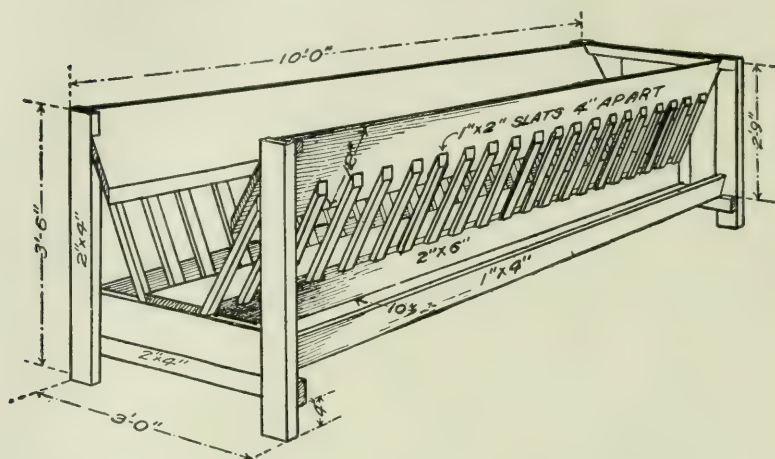


FIG. 40. — A SATISFACTORY COMBINATION HAY AND GRAIN RACK.

Conditioning Ewes for Mating. — Sheep in thrifty condition breed more readily than those that are poor and run down. Therefore, at the beginning of the breeding season, the flock should be putting on flesh rather than losing it, for this tends to facilitate or expedite breeding. Also, the offspring of healthy ewes are more vigorous than those from weak, poor stock.

About ten days before the ram is turned in with the flock, it is advisable to give the ewes much better pasture than they have had previously, and possibly some grain. Fresh alfalfa, clover, broken pumpkins, fresh rape, and other succulent feeds may well be given at this period. When the ewes are too fat, however, they do not breed well, hence they should be put on rather lean pasture for a few weeks before the breeding season. Some sheep owners believe better results are secured when the feed for the flock is reduced again the last day or two before the ram is turned in, but this is doubtful.

When an accurate breeding record is to be kept, numbered metal tags, available on the market, should be placed in the ears

of the ewes, and the same numbers should be stamped on their sides with wooden or steel stencils. Obviously, it is desirable to have the lambs come so that they will all be of nearly the same age and size.

Preparing Ram for Breeding Season. — The breeding season should find the ram in as vigorous a condition as possible. In many flocks the ram is turned in at breeding time and given no special attention. Such management is inadvisable under some conditions but it works out well under others. If the ram is of a nervous temperament it is better to leave him with the ewes continuously than to remove him for part of the day; but when he has a quiet disposition it is usually advisable to keep him away from the flock about half the time. Depending on his age, vigor, and the way he is handled, a ram will serve anywhere from 35 to 75 ewes during a breeding season of about five weeks.

Breeding Ewe Lambs. — When ewe lambs are given special care during the period of gestation and when lambing, breeding them under farm conditions, where they can receive individual attention, has few bad results. Careful experimental work has proved that under good management the growth of the ewe lamb is not checked by breeding, that the fatalities from lambing are few, and that the young ewe makes a fairly good mother.

Many experienced sheepmen, however, vigorously condemn the practice. All goes well if — *and it is a big "if"* — the right care is given the young ewe. The trouble is that, however good the intentions of the owner may be at the time of breeding, it is the way of human nature to forget, and as time goes on the majority do not remember to give the ewe lambs the special care which they need. For this reason it is a much better practice for the average farmer, busy with many cares, to let the ewe lambs run over one winter unbred. When the first lamb comes the ewe should be about twenty-four months old.

The ewes should have shelter in stormy weather, but the rest of the time it is best for them to be on open pasture where they can exercise and develop strength and vitality. If they are given enough grain, clover, and alfalfa hay to make sure of continuous gain, spring should find them in first-rate condition for lambing.

Care of Ewes during Pregnancy. — In the care of breeding ewes, feed plays an important part. Overfeeding is to be as much avoided as underfeeding. The aim is to have the ewes in the breeding flocks firm-fleshed, vigorous, and plump so that the resulting lambs will be in good condition (Fig. 41). The practical shepherd regulates the feed given the flock according to its condition. Twice each day is often enough to feed the breeding



FIG. 41. — PREGNANT EWES MUST HAVE PLENTY OF EXERCISE IN WINTER TO KEEP FIRM-FLESHED AND HARDY.

ewes, and it is an excellent practice to give them some of the rough feed outside at a little distance. In this way they are induced to take the necessary exercise. Two pounds of succulent feed, 2 pounds of dry feed, such as cut corn fodder or clover hay, and $\frac{1}{2}$ pound of bran and oats or other similar grain, is about the daily requirement for a breeding ewe weighing 150 pounds. Twice this amount of grain should be given just before lambing time, since the ewes must be kept in condition to take care of their offspring, lambs being a milk product.

Corn fodder, pea straw, clover hay, oat hay, oat straw, and millet are all suitable winter fodders for breeding ewes. Corn is not so satisfactory a grain ration for the breeding flock as oats, as it produces too much fat and lessens the vigor. Oats fed the

first part of the season, followed by bran as the lambing season approaches, make an excellent grain ration.

Breeding ewes should always be given some succulent food. Before lambing, 3 pounds daily is sufficient, but afterwards unlimited quantities may be given to increase the milk flow. Sugar beets, mangel-wurzels, turnips, or silage are all approved succulent sheep feeds. In feeding silage to ewes, care must be taken that the corn is well matured and that no spoiled, frozen, or moldy silage is fed, as this often causes serious disorders.

After the ewes lamb, but before the sheep are turned out to pasture, liberal feed must be given them in the lot. From 1 to 1½ pounds of bran, 2 pounds of hay, and plenty of succulent feed are needed by each ewe daily during this period. As soon as the pasture forage is strong it is well to turn the ewes into it, providing some grain at first to supplement the grass until it has sufficient nourishment in it.

Summer and Fall Feed. — In the summer when the pastures are dry, some provision should be made for green fodder. Rape, rye, and vetches are the green feeds most commonly used. In the fall, stubble forms the principal sustenance for the breeding flock. Fence corners and strips in fields from which crops have been gathered can also be pastured for a few days at this time, saving the clover and grass pastures.

Water and Salt. — Although sheep do not require as much water as some other domestic animals, they need a regular supply of pure, fresh water to do their best. Water dissolves nutrients in the system of an animal, serves as a medium for transferring food to different parts of the body, and acts as a vehicle for eliminating waste and poisonous products from the system. When the weather is cool, the vegetation succulent, and heavy dews are frequent, sheep do not require as much water as at other times.

With sheep, as with other kinds of livestock, salt is not only essential to the best development but also helps to secure quiet grazing. Sheep will consume about 1½ pounds of salt per head during a summer season of 100 days. Crystal, coarse sack salt, or regular dairy salt should be used. In the feed lot it can best

be fed in wooden troughs, and a supply should be available to the animals at all times.

Dipping.² — Ticks, lice, and scab mites may infest the farm flock at any season of the year. These vermin irritate the animals and they lose a great deal of vitality as a result. By dipping the flock in a good disinfectant the infestation can be reduced to a minimum if not entirely eliminated. The best season for dipping is while the weather is still warm, and before the wool has grown to full length.

Lambing Time. — When lambing time approaches the shepherd must be prepared to be on hand night and day to care for the ewes and lambs. During the night he can plan on sleeping from about 12 o'clock to 4 A.M., as lambings are distinctly at a minimum during those hours.

If the lambing is to be conducted under shelter, as it usually is in the colder farm sections, the flock must be given as much barn space as possible. Warm quarters are a necessity to the newborn lambs, — for they are wet and in need of a warm place, — if they are not to become chilled. When the whole barn is very cold it is often possible to board off a section in the warmer part for lambing. If hay or straw is stuffed in the crevices between the boards, a fairly comfortable place may be provided.

For the first three or four days after the lamb is born it is better to place both ewe and lamb in a pen about 4 feet square, rather than to let them mingle with the flock. This enables the ewe and lamb to become acquainted more quickly, and the lamb is protected, while it is still weak, from being bumped and knocked about by the rest of the flock. It is also easier for the shepherd to care for the ewe and her offspring in all details, when they are penned.

Care of Ewes and Young Lambs. — All during the winter the pregnant ewes should have plenty of exercise, but care must be taken that they are not hurried or worried in any way. Keep them out of doors in all favorable weather. As the lambing season approaches, the breeding flock should be given more attention than hitherto. Separate the ewes that are in poor

² For a discussion of dips, vats, and procedure in dipping, see page 180.

condition from the rest of the herd and give them feed that will stimulate the flow of milk; but just before lambing avoid feeding too much grain. The last day or two, substitute roughage for most of the grain ration. Silage, if not moldy or frozen, is satisfactory at this time. Swedish turnips and mangels, when well ripened, are also valuable additions to the rations of the pregnant flock.

At the approach of lambing time, remove the most advanced ewes from the rest of the flock and place them in a pen by themselves. Such pens may be permanent in character or they may be made of two light panels hinged together and placed in one corner of the barn. A pen of this type allows the ewe to see the rest of the flock and this helps to keep her from becoming excited or nervous. If the weather is cold, a blanket or canvas may be thrown over the pen.

Certain supplies necessary at this time should be provided if the flockman does not have them on hand. The more important items are a large syringe and a small one, a glass graduate in which to measure medicine, a sheep pelt to be used for warmth when necessary, a large jug to hold hot water, and some arrangement for heating water. Among the drugs commonly kept for emergencies are the following: tincture of iron, gentian, and ginger to be used for tonic; castor oil, Epsom salts, and raw linseed oil for physic; iodine for navel cords and swollen udders; and soap to use in water for injection. Directions for use of these medicaments are found in any standard book treating of the health of animals.

When the time of parturition is very near the ewe becomes uneasy and walks about, paws at the bedding and sometimes bleats and looks for her lamb. Before this, however, the ewe's physical appearance changes and she becomes very sunken in front of the hips. If the lamb is in the right position, head foremost, and the ewe is strong and in good condition, little difficulty is to be expected in lambing. The ewe should be left undisturbed during her labor unless the pains cease or unless they last longer than is usual. When this occurs, the shepherd must help. With hand and arm bathed in disinfectant and nails closely

trimmed, he usually can change the position of the lamb by inserting his hand and pushing it into its proper place. Greasing the hand with vaseline makes it easier to introduce it. Once the lamb is in proper position, normal birth usually follows.

After delivery the ewe must be carefully watched for a number of days to see that the afterbirth, or placenta, is cast and that the bowels and udder are in good condition. Good food, clean water, and shelter from cold drafts should be provided.

Feeding the Ewe. — When the ewe is in poor condition grain or bran may be given her within a few hours after the lamb is born. Otherwise the flow of milk will be scanty and the lamb poorly nourished. If the ewe is in good condition, little or no grain need be fed for three or four days after lambing. When the ewe has no appetite after a few hours, even when tempted with dainties like choice clover and alfalfa hay, linseed oil meal, and bran, it may be possible that a physic is needed, and, if so, one should be administered without delay. Ice cold drinking water is likely to cause injury to the ewe immediately after lambing, especially if given in quantity. Until her first thirst is satisfied, it is much safer to give small quantities of tepid water rather than to allow her to drink as much as she chooses at once.

Disorders of the Udder. — The ewe's udder may become swollen and cause much trouble. Diseased udders should be milked out, bathed with hot water, and painted with iodine or rubbed with turpentine and lard daily until the swelling goes down. If pus forms, an opening for drainage should be made and a good disinfectant applied to the diseased parts. As some forms of swollen udder, or garget, are contagious, the ewe with an udder so sore she will not allow the lamb to nurse should be put in a pen by herself, away from the rest of the flock, and the lamb fed by hand until the ewe is able to care for it. The lamb should not be allowed to suckle other ewes, as the milk may have infected the lamb's mouth and if so any other ewe that suckled him would be exposed to infection.

Sore teats is a common trouble with the ewe and may be caused by the sharp teeth of the lamb or by the formation of pock-like sores. If the lamb is the cause, it should be taken

away and fed by hand. If the trouble is pock-sore, the sores should be opened and the teats washed daily with a disinfectant. One part of sheep dip to 25 parts of water makes an excellent application.

Caring for Orphans. — Many lambs start in life as orphans, either because of the mother's death or because of her inability to suckle them. Occasionally a lamb finds itself facing orphanhood because its mother, apparently deeming maternity a bore, will not own it. In the latter instance, much persistence and patience are needed by the shepherd to teach the ewe the error of her ways and to get the lamb owned.

In some instances, where twins are born, the ewe is able to suckle only one, and the other lamb falls into the orphan class. A foster mother is the first thing to be sought for the orphan. If another ewe has recently lost her lamb, she can oftentimes be persuaded to take the orphan as a substitute. Sometimes a ewe with one lamb has milk enough for two. The various methods of deceiving the ewe and making her think that the orphan belongs to her have been described in Chapter VIII.

When no foster mother is available the lamb must be raised by hand. The best substitute for ewe's milk is milk from a fresh cow. The milk for the bottle-fed lamb should be heated to blood temperature, and the bottles and nipples must be kept *scrupulously* clean. Small feedings offered frequently for the first week or two give the best results, and one night feeding the first two weeks is sufficient. The first day the lamb should be fed 2 tablespoonfuls of milk every hour. After that the amount fed and the time between feedings can be gradually increased. The orphan lambs should be kept warm and dry, and not too many should be placed in one pen.

Care of Weak Lambs. — Newborn lambs that have been chilled may be placed in a warm bath, rubbed dry with a towel, given a stimulant, and wrapped in a warm blanket or sheepskin until they revive. A little warm milk should also be fed. Do not keep them away from the mother any longer than is necessary.

When the lamb is about two weeks old it will begin to crave some solid food, especially if the ewe has not plenty of milk.

Everything possible should be done to stimulate her milk supply, but if the lamb continues to be hungry, corn meal or ground oats should be given to supplement the mother's milk. The majority of sheep growers, however, do not like to feed lambs grain until they are four weeks old, unless the supply of mother's milk is scanty. The grain for the lambs can be given them in a "creep" which is large enough to allow the lambs to pass in and eat, but small enough to keep out the sheep. Corn meal or clean cracked corn, oil meal, and barley make an excellent ration. Allow the lambs to have all they will eat. At all times give the lambs plenty of sunshine.

Docking and Castrating. — If proper care is taken, there is no danger from docking and castrating lambs. Uncastrated lambs are restless, they do not put on flesh rapidly, they are coarse and badly shaped, and they often sell for several cents a pound less than the altered ones. Sometimes their meat has a strong flavor, and livestock buyers discriminate sharply against them in favor of the castrated lamb. Even when marketed young, they should be castrated.

Lambs should be castrated while they are between ten and twenty days old. The operation should be performed on a sunny day. They should be separated, quietly, from the rest of the flock, and a clean pen, in which they can be held after the operation, should be provided. Hands and knife should be thoroughly disinfected before commencing. Instruction in the methods of castrating and docking is given in Chapter VIII.

Weaning Stocker Lambs. — Notwithstanding the fact that the mother's milk is the best food that can be given lambs, they should be weaned before the advent of the hottest part of summer. The ewes will do better, and the lambs can be kept by themselves on clean pasture free from parasites.

After the lambs are separated from their mothers they will need attention for three or four days to see that they learn the way to their drinking place, to shade, and to the feed. Where good farm sheds are available, it is most profitable to have the lambs born in February or March. By this procedure, they learn to eat grain before there is grass for them, and at three or

four months of age (weaning time) they are ready for market. Cracked corn should be given in increasing quantities, supplementary to the oat, bran, and oilcake feed, until it forms about one-third of the lamb's ration. In the Corn Belt the lambs are often fattened by turning them into the corn field (Fig. 42).



FIG. 42. — CORN CAN BE HARVESTED CHEAPLY BY LAMBS THAT ARE BEING FATTENED FOR MARKET.

Care must be taken to see that the lambs are kept growing from the start. After they are taken away from their mothers, put the ewes on rather poor pasture for about a week to stop the milk flow.

Marketing Lambs. — When grain is high and grass cheap and of a good quality, it may pay to carry farm lambs through the summer and market them in the fall. Under ordinary conditions, however, there is more money to be made if the lambs are marketed when they are three or four months old. At that time

they still retain their baby fat, they are free from parasitic troubles, and the hot weather has not thinned them down. Loss by dogs is also eliminated, and the market is usually better than it is later when the western lambs flood the market. At the baby-fat age if properly fed, the lambs should weigh from 60 to 70 pounds.

After the lambs are weaned, keep the ewes only in fair flesh until two weeks or so before breeding time. Then, as explained in an earlier part of this chapter, they may be put on very good pasture. An unpastured meadow is excellent, but any good pasture will do. The practice of turning the ewes on green strong pasture, termed "flushing," results in the ewe's health receiving a sudden stimulus. This sudden stimulation causes multiplication in the body cells, and the reproductive cells as well become more active. Unless the ewes have been on poor pasture, however, it is difficult to flush them.

Sheep in Hot Weather. — Sheep will not do well in hot weather unless they have reasonably cool quarters, plenty of fresh water, and pasture so arranged that little traveling is required to reach it. Airy barns, or large trees with branches so high that the sheep do not tear their wool on them, provide the best shade. The air under bushes is likely to be heavy and muggy, and sheep that must seek thickets of brush for shade will not do well. The sheep should not be required to travel long distances from the shade to reach good pasturage. Either they will stay too long in the shade and not obtain enough feed, or they will stay in the sun too long and get overheated.

Shearing and Marketing Wool. — The wool clips should practically pay for the flock's maintenance and the interest on the money invested. Most farm flocks, except in mild climates, are shorn in April or May. If shearing is done too early, there is danger of the sheep becoming chilled, and if it is postponed too long they will suffer from heat. In recent years machine shearing on the farm is taking the place of blade shearing. All precautions must be taken to prevent any kind of foreign material from getting into the wool after it is clipped, and before it is baled, if it is to sell as a first-class product. Owners of small

flocks are at a handicap to dispose of their clips advantageously. In recent years coöperative marketing of wool has been found to give the small flock owners better prices.

Future of the Farm Flock. — On some occasions the price of sheep has reached high levels, and their numbers have increased rapidly. This was true during the late European War when hundreds of farmers went into the sheep business. With the falling market which followed the culmination of hostilities, there were many financial losses. Others failed because they lacked knowledge or were careless in handling their flocks.

The raising of farm sheep successfully seems to be in the hands of the producer. If he markets only a superior product, the prejudice of that portion of the American public that discriminates against lamb and mutton will be broken down gradually. At present only about $6\frac{1}{2}$ pounds of lamb and mutton per capita are eaten in this country as against about 80 of beef and 78 of pork. The farmer himself may well learn to eat lamb instead of confining his meat diet almost exclusively to pork products. The "muttony" taste to which so many object is the result of improper feeding and slaughtering, if it is present in lambs. The meat from old rams and wethers is sometimes rank in flavor, and undoubtedly the fact that this class of meat is sometimes sold as lamb has had much to do with the present prejudice against a meat, which, under the right circumstances, is both delicious and nourishing.

The future of the farm flock depends not only on the owner's marketing a product of desirable quality, but also on his preparing the clip properly for market, for in successful sheep raising the wool must give good returns. The age of using sisal twine for tying up bales of wool has all but passed except in farm herds.

Collective marketing of the wool will enable the flock owner to make sure that he is obtaining the best price possible for his clip. This plan is growing in increasing favor in many important sheep-producing states.

Success in Farm Sheep Husbandry. — The essentials for success in sheep raising on the farm are (1) the use of good judgment in starting the flock, (2) giving the flock the best of care

and management, (3) maintaining a proper balance between the sheep industry and the other enterprises on the farm, and (4) procuring the fullest possible coöperation of neighbors engaged in the same business. Any farmer who is willing to give his flock the same amount of intelligent care that he gives to other livestock will not only reap financial profit, but by improving the soil he will bring into cultivation land which has been unprofitable. It is usually best for the beginner in sheep husbandry to follow the practices of the most successful sheepmen in his locality as they have solved many local problems which the beginner is likely to encounter.

QUESTIONS

1. Discuss the relation of the farm flock to soil fertility.
2. What is the chief handicap in sheep raising on the farm?
3. Are sheep reared successfully on irrigated farms?
4. In establishing the farm flock, (a) how many ewes would you procure and of what age? (b) Would you purchase purebreds or grade ewes? (c) Why are western ewes generally preferable to native or farm-grown breeding stock? (d) If grade ewes are purchased, would it pay to use a purebred ram? If so, why?
5. Discuss the type of buildings that should be provided for the flock.
6. Discuss the proper condition of the ewes and the ram at mating time.
7. Why can ewes be bred at an earlier age on the farm than on the range?
8. How would you handle the ewes during pregnancy with respect to (a) feeding, and (b) exercise?
9. Outline how you would proceed at lambing time, with special reference to (a) quarters, (b) segregation of lambed and unlambd ewes, (c) abnormal lambing, and (d) care of orphan and weak lambs.
10. At what age should lambs ordinarily be marketed for the best profits?
11. When should the ewes be sheared?
12. Outline briefly the future of sheep raising on farms in the United States.

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CHAPTER X

THE WOOL CROP AND THE WOOL GROWER

From the dawn of history down to the present time, the wool of the sheep, the function of which is to protect and conserve the warmth of its body, has been used by the human race for clothing.

The aim of this chapter is to present the experimental and practical information about wool that is most useful to the producer. Many of the terms used in the wool trade are technical. In order that the chapter may have the greatest possible usefulness, these terms are alphabetically listed and defined, at the end of the chapter.

Wool Production in the United States. — The United States is one of the principal wool-producing countries of the world. A comparison of the world's wool production in 1916 showed that Australia and New Zealand together produced approximately 25 per cent of the world's wool clip; the Russian Empire, 15 per cent; the United States, 12 per cent; Argentina, about 6 per cent; the Union of South Africa, 6 per cent; Asiatic Turkey, 3.3 per cent; and France, 2.8 per cent. The production of wool in the United States, with respect to its population, between 1915 and 1918 inclusive, was 2.8 pounds. In 1925 the United States was second among the nations of the world in the production of wool, the report reading as follows: Australia and New Zealand combined, 905,000,000 pounds; the United States, 301,000,000 pounds; Argentina, 175,000,000 pounds; Russia, 195,000,000 pounds; British South Africa, 185,000,000 pounds; Uruguay, 110,000,000 pounds; and the United Kingdom, 96,086,000 pounds.

Some American wools are equal in value to the best foreign wools of the same class. Often, however, American wool brings a lower price than foreign wools. This is because of its higher shrinkage and its unfavorable appearance, which is due to less careful preparation for market.

Wool as an Article of Commerce. — As one of the most important clothing materials, wool ranks with food and fuel as a human necessity. The purchase of wool clothing varies, however, with the fluctuations in price. This makes the demand for wool somewhat irregular, for the combined needs of the human race are not precisely the same from year to year, yet the average consumption of woollen goods of all kinds is reasonably similar from season to season. When the buying power of the population is strong the purchase of clothing is correspondingly greater than the purchase of food and fuel, chiefly because of man's desire for variety in wearing apparel. In periods of depression, however, the lessened buying power tends to deflate the price of wool more, possibly, than that of food. This statement holds true generally, but during the last few years, although the buying power of the population of the United States has been high, the consumption of wool has been comparatively low. The dictates of fashion probably have more effect on the wool industry than on any other line of commerce; at one time coarse, and at another time fine grades of wool are in demand.

Amount of Wool in Cloth. — Many persons have the impression that the entire fleece is used in the manufacture of clothing. Such statements as the following are frequently seen in trade journals and elsewhere:

"Seven pounds of wool in the grease will make as good a suit as the average man wears today. At 70 cents a pound the wool in a suit is worth \$4.90. With wool reduced to 50 cents a pound it is worth \$3.50."

In the first place the finished cloth is by no means equal to the amount of scoured wool. When wool is prepared for manufacture it is closely graded so that only a portion of the entire fleece enters into the manufacture of a particular fabric.

As the weight per yard of goods varies greatly, it is not possible to give the amount of wool required in the manufacture of a suit of clothes or other garment, but the number of pounds of wool required to produce a pound of cloth can be given. One pound of worsted cloth requires an average of 3.73 pounds of grease wool, the variation being from 3 to 4.64 pounds. The average amount of scoured wool required is 1.37 pounds per pound of

cloth. For worsted cloths from 2.5 to 4.55 pounds of grease wool are required.

Structure and Properties of Wool Fiber. — There is no clean-cut distinction between wool and hair. Both originate from hair follicles in the skin. Their structure is practically identical and they are nourished by similar glandular tissues. However, when placed under a microscope a wool fiber and a true hair may be distinguished readily (Fig. 43). In wool the surface cells are clearly interlocked or serrated and somewhat resemble the scales on a fish. In hair the serrations are much less conspicuous as the surface covering is pushed into successive layers, giving a somewhat smooth appearance.

The wool fiber consists of three distinct parts. First there is the epidermis or surface of the fiber, which consists of a series of scales lying one upon the other. These scales are roughened on the edges and thus give the fiber excellent spinning properties. Then there is the cortex, or portion immediately beneath the scaly surface. This part of the fiber gives it strength and elasticity. Beneath the cortex there is the medulla or pithy core of the fiber, usually well developed in the coarse-wooled breeds but rarely found in fine-wooled breeds. The pith is channeled and serves to conduct the nutrients from the glandular tissues at the root of the fiber.

The composition of wool fiber is approximately as follows:

Pure wool fiber.....	42-50 per cent
Yolk and suint.....	20-22 per cent
Fatty material.....	7-10 per cent
Moisture.....	10-20 per cent



FIG. 43. — FIBER OF FINE WOOL MAGNIFIED 500 TIMES, SHOWING THE SCALES.

The susceptibility of sheep to their environment is an important factor in the development of wool. This is fully appreciated and understood by the manufacturer, but unfortunately not by the average grower. A change of feed, location, climate, or the presence of disease in a sheep changes the properties of its wool.

GRADES OF WOOL

The diameter of the fiber determines the grade of wool. Other factors, such as extreme length, unusually good or poor quality of wool, or marked unevenness in quality sometimes cause a fleece to be graded either higher or lower than it would be ordinarily.

In the United States the nomenclature of wool grades has not been definitely established and differs from that used in England.

English or Spinning Count System. — In England the nomenclature originated through the practice of basing the grade name upon the number of hanks of yarn which could be made from one pound of combed wool or top. One hank was the equivalent of 560 yards. Accordingly, 1 pound of wool of 64's quality would make 64 hanks of yarn, each 560 yards long. In contrast to this, a coarse wool of 40's quality would make only 40 of these hanks. This nomenclature has been used in the wool trade for a long time, and although the terms are still in use, they no longer have the definition given above. It is evident that fine wools, such as would grade 70's and 80's, can be spun into finer yarns than would be indicated by the "spinning count," according to the original use of the term.

United States System. — Until 1926 the United States had its own grade names for wool. The terms are "fine," "half-blood," "three-eighths blood," "quarter blood," "low quarter blood," "common," and "braid." It is assumed that the term "blood" originated when the Merino sheep began to be intermixed with other breeds. A "three-eighths blood" wool probably represented a fleece from a sheep which was three-eighths Merino. These grade terms are no longer associated with the breed of sheep from which the wool has been taken; they refer definitely to the diameter of the fiber.

In order that the grades of wool might better meet the requirements of the manufacturer, dealer, and grower, the United States Department of Agriculture in 1923 established official wool standards, using United States grades. These standards did not prove satisfactory, hence in 1926 the Department proposed a new

set of standards, using the British system of spinning counts to designate fineness. It is presumed that the new classification and nomenclature will replace the old grade names. The list of the new standards, based on spinning counts of the wool, and the corresponding United States grades, are as follows:

Official Standard Wool Grades	Corresponding "United States" Grades
80's } 70's } 64's }	Fine
60's } 58's }	Half Blood
56's	Three-eighths Blood
50's } 48's }	Quarter Blood
46's	Low Quarter Blood
44's	Common
40's } 36's }	Braid

CLASSIFICATION OF WOOL

The classification of each of the first five grades of wool is made according to the length of staple. The classifications are combing, French combing (or baby combing), and clothing. Combing wools must be long enough to permit of combing by the English system of worsted manufacture. French combing implies a shorter wool and one that can be combed by the French system. Clothing wool is not long enough to be combed economically and is used for the making of materials other than worsted.

The classification, as far as concerns the length of wool, depends upon the grade. If a wool is coarse it must be proportionately long to classify as a combing wool. The following standards have been adopted in the United States Department of Agriculture:

Grade	Combing length	French combing length	Clothing length
Fine.....	Over 2 ins.	1 $\frac{1}{4}$ ins. to 2 ins.	Under 1 $\frac{1}{4}$ ins.
$\frac{1}{2}$ blood.....	Over 2 $\frac{1}{4}$ ins.	1 $\frac{1}{4}$ ins. to 2 $\frac{1}{4}$ ins.	Under 1 $\frac{1}{4}$ ins.
$\frac{3}{8}$ blood.....	Over 2 $\frac{1}{2}$ ins.	1 $\frac{1}{2}$ ins. to 2 $\frac{1}{2}$ ins.	Under 1 $\frac{1}{2}$ ins.
$\frac{1}{4}$ blood.....	Over 2 $\frac{3}{4}$ ins.	1 $\frac{1}{2}$ ins. to 2 $\frac{3}{4}$ ins.	Under 1 $\frac{1}{2}$ ins.
Low $\frac{1}{4}$ blood.....	Over 3 ins.	2 ins. to 3 ins.	Under 2 ins.

Grades in the United States. — Michigan and New York have much the same grades of wool, and some of them compare favorably with those of Ohio and Pennsylvania.

Kentucky, Indiana, Missouri, and Wisconsin wools are not as fine in character. They seldom grade higher than one-half or three-eighths blood.

Tennessee and Virginia produce considerable wool of medium quality. This is because the sheep industry in this region is managed on the basis of early spring marketing. Georgia and some other southern states produce rather coarse, light-shrinking wools.

Certain western wools are called "territory" wools. The term probably originated from the fact that the western states were territories until long after the wool growing industry was established. The wool from this vast region is usually quoted on a scoured basis. This plan affords uniformity, for there is a wide variation in the shrinkage of the wool produced in different localities, as well as from season to season, so that quotations on a scoured basis are necessary.

Texas wool is probably as near that of the Ohio type as any western wool, the Merino blood distinctly predominating in Texas herds. This wool sometimes shrinks only about 55 per cent.

California wool is quoted as northern, middle, or southern counties (not territory) wool. The northern clips represent a year's growth, whereas the middle and southern wools are often clipped twice a year. Both spring- and fall-clipped wools are regarded highly as a material for felting.

Oregon wool is not included in the territory class. It is of high quality but its shrinkage is high. Some of the best grades of staple shrink as much as 80 per cent.

Montana and Wyoming together produce among the very best of the territory clips. The Montana wool is light, of good length, and attractive in appearance. Wyoming wool is not so soft in character as the Montana wools, a factor accounted for by the alkali soils. It scours out white and attractive-looking, however.

Idaho wools are generally of lighter shrinkage than those of surrounding states. Western Idaho produces a long, fine staple, although in the eastern part of the state the wool is somewhat shorter.

Nevada, Utah, Colorado, and Washington wool is inclined to be short, probably because much of the range is overgrazed. Most of this wool is of high shrinkage but of good quality.

Washington is said to produce the heaviest-shrinking wools of any western state, the average being about 70 per cent. This high shrinkage is due chiefly to the natural grease in the wool.

New Mexico and Arizona wools are markedly uneven in character. They are frequently poorly prepared, are often placed on the market untied, and the low one-quarter blood is not uncommonly mixed with the finer grades. The shrinkage varies from 40 to 75 per cent.

The Dakota, Kansas, and Nebraska clips may be included in the territory wools. They usually carry considerable sand and dirt, but less than is found in wool from states farther west. They are usually classed as "semi-brights."

Grades According to Breeds. — As indicated, it is not possible to grade wool strictly according to the breed of sheep, because of the variation within a breed and the influence on the clip of climate, feed, and many other factors. The following list, however, shows approximately how wool from the breeds popular in this country usually grades, according to the United States system. The grade given first is the most typical for the breed.¹

¹ Adapted from Wilson, J. F., "Wool Production in California." Col. of Agr. Univ. Calif., Ext. Cir. 12, 1927. This circular has been used for much valuable information in the preparation of this chapter.

Classification	Name of breed	Grade
Fine-wool breeds.....	{ American Merino Delaine Merino Rambouillet	Fine Fine Fine and fine medium
Middle-wool or medium-wool breeds	{ Black-faced or " Down " breeds Southdown Hampshire Shropshire Suffolk Oxford Dorset Corriedale Cheviot Tunis	$\frac{1}{2}$ blood, $\frac{3}{4}$ blood $\frac{3}{8}$ blood, $\frac{1}{4}$ blood $\frac{3}{8}$ blood, $\frac{1}{4}$ blood $\frac{3}{8}$ blood, $\frac{1}{4}$ blood $\frac{1}{2}$ blood, low $\frac{1}{4}$ blood $\frac{3}{8}$ blood, $\frac{1}{4}$ blood $\frac{3}{8}$ blood, $\frac{1}{4}$ blood, $\frac{1}{4}$ blood $\frac{1}{2}$ blood, $\frac{3}{8}$ blood $\frac{3}{8}$ blood, $\frac{1}{4}$ blood
Long-wool breeds.....	{ Lincoln English Leicester Border Leicester Cotswold Romney	Braid Braid, common Common, low $\frac{1}{4}$ blood Braid, common Low $\frac{1}{4}$ blood, $\frac{1}{4}$ blood, common

Crossbreeding for Wool. — In the West it is found that lambs of the Down breeds (black faces) give the biggest returns on the market. It is obviously important so to breed and husband the band as to get the largest possible number of good-quality lambs for slaughter, but such breeding must provide also for a maximum of good-grade wool from the ewes.

Although the Down sheep are prolific, they are not suitable for the range because they lack hardiness, have poor herding instincts, and tend toward black on the shanks and head. The fine-wooled breeds are hardy and admirably adapted to range conditions, but the lambs are not satisfactory from the butcher's viewpoint. Certain crossbreeding practices under some conditions of forage and climate serve to combine many desirable characteristics of fine-wooled and Down breeds, although in various sections the use of Merinos and Rambouillet sheep seems to give excellent results.

The following crossbreeding practices have given good results in certain localities:

1. Mating of the long-wooled ram with the fine-wooled ewe results in the production of about as much grease wool as is

secured from fine-wooled sheep and considerably more grease wool than is produced by the Down breeds. The staple is long and free from black fibers.

2. The use of the Romney for crossing with fine-wooled ewes is popular in some sections of California. The wool is of good weight and is finer than that of the Lincoln and Rambouillet ewes or the Cotswold and Rambouillet ewes. The superior length of the wool makes this cross valuable where shearing is done twice a year.

3. The Cotswold and Rambouillet crossbred produces chiefly three-eighths blood wool of combing length and of superior brightness. The fleece, however, is uneven and tends toward coarseness on the thighs and britch.

4. The Lincoln and Rambouillet crossbred produces a heavy fleece, grading mostly three-eighths blood. This cross is common in the Rocky Mountains. The fiber does not, however, possess the fineness of the Romney and Rambouillet crossbred.

The use of rams of the Down breeds to improve the returns from the market lambs is good practice, provided one has enough ewes of pure strain to maintain the purity of the ewe band. Ewes with considerable of the Down blood shear lightly with advancing years and the wool becomes inferior because of the presence of black fibers on the head and legs. As a general recommendation, the use of Down breeds for crossing had best be confined to small farm flocks where profits from the wool are of minor importance. It is a serious mistake to keep for breeding purposes the crossbred ewe lambs. Breeding a portion of the crossbred ewes back to fine-wooled rams for purposes of retaining the ewe lambs tends toward confusing the grader of wool.

FACTORS THAT DETERMINE WOOL VALUES

By giving the proper care and attention to the production and handling of wool, many a progressive sheepman has shown a good yearly profit, whereas his neighbor, with the same class of sheep, has failed because he neglected certain details and principles which make for good quality of wool.

The points to be considered in wool are essentially as follows: (1) grade and length, (2) shrinkage and condition, (3) character or crimp, (4) purity and strength, and (5) retention of natural color.

Grade and Length. — Although the demand for the various grades of wool is an important factor in determining its worth, the finer the wool, in general, regardless of grade, the greater its value when scoured. Likewise, wool of sufficient length, or classification, to be used as combing, and suitable for manufacture into worsted, is always of greater value on a scoured basis than clothing wool of the same grade and of similar character. The longer the wool is, also, in the fine grades (unless it is of excessive length, such as a two-year-old clip), the greater is its value.

Shrinkage and Condition. — Shrinkage is the most important and, indeed, the most variable factor affecting wool prices. By shrinkage is meant the percentage of grease, dirt, and other foreign substances contained in the fleece when it is removed from the sheep's back. A fleece that weighs 10 pounds and has a shrinkage of 60 per cent would furnish 4 pounds of scoured wool. Shrinkage is due chiefly to fatty substances and to dirt, which are present in varying quantities in all natural wool.

Shrinkage ranges from about 30 to 80 per cent and is determined chiefly by (1) grade, (2) individuality, (3) climate and soil, and (4) care and management of the band.

Wool from the fine-wooled breeds seldom shrinks less than 60 per cent, whereas that from coarse-wooled breeds seldom shrinks more than about 50 per cent. This difference is due to grade, hence it is associated with the particular breed of sheep. In individuals of the same breed and age in a given flock, however, the shrinkage may vary as much as 10 per cent. Climate, notably rainfall and wind, influences shrinkage. In localities of heavy, prolonged rainfall much of the dirt is worked out of the wool. On the other hand, where the wind movement is high, sand and other inert matter are blown into fleeces. In parts of California and elsewhere, vegetable matter in the wool is sometimes serious. Fruiting parts of bur clover (*Medicago spp.*) and cockle bur (*Xanthium spp.*), and awns of barleygrasses (*Hor-*

deum spp.), certain brome-grasses (*Bromus spp.*), and many others, often lower the value of the wool. Heavy infestation with these vegetable parts makes carbonization necessary.

Comparatively little can be done to decrease the shrinkage of wool so far as concerns the management of the band. The control lies chiefly in keeping, after seed maturity, the herd out of fields that are infested with plants whose fruiting parts adhere to the wool. Also, through the use of properly constructed feeding racks and suitable bedding areas, when prolonged corral feeding is necessary, damage to the wool, due to the accumulation of vegetable matter, may be more or less avoided. Breeding up the band, through selection, so that the fleece carries only enough oil to protect the fiber from becoming harsh, notably where fine-wooled sheep are raised, offers good possibilities. Wool of light shrinkage is more attractive and is more easily scoured than very greasy wool.

Condition refers to the amount of foreign matter present in grease wool. There should be only enough fatty substances to protect the fiber from becoming harsh when it dries, and these should be evenly distributed from the base to the tip of the fiber. A white or creamy-colored yolk is more desirable than one that is yellow or otherwise deep-pigmented, because white wools are more easily scoured.

Character or Crimp. — In the character or crimp (waviness) of the wool fiber the manufacturer reads its past history and can determine how it can best be used for manufacturing purposes. In general, the crimp is a measure of the fineness of the fiber. The greater the number of crimps per inch the finer the fiber. In the finest wool of Merino blood there are sometimes as many as thirty-five crimps to the inch, whereas in that of the Lincoln or Cotswold there may be only two crimps to the inch. The elasticity of the fiber depends largely on the number and kind of crimps that it contains. Elasticity gives strength and pliability to cloth. The crimp insures that the fibers come in contact with each other at many points, so that the whole becomes well interlocked. Character refers also to the softness to the touch, a factor of importance to the manufacturer.

Purity and Strength. — Purity refers to the absence of such objectionable materials as kemp, hair, and wool of a dark color. Kemp is the most objectionable because it does not take dye and because it has little elasticity or strength. Dark-colored wool fibers are objectionable because they can not be bleached out, hence wool containing them must be used for the manufacture of dark fabrics.

Black and brown fleeces should never be sacked or baled with other wools. After they have been packed together for some time the fleeces "intertwine." A lock of black in any wool intended for white goods does great damage. Black, gray, and brown wools are more or less in demand but they should always be sold according to color. Likewise, badly cotted or matted fleeces should also be sacked separately as they must be given special treatment by the manufacturer. Locks or small pieces of wool that fall out when the fleece is handled should also be sacked separately. Frequently sheepmen fail to separate the bucks' fleeces from the others. Bucks' fleeces are usually much heavier in grease, the fiber is coarser, and the spinning qualities are lower than from other stock, so that for these and other reasons it is undesirable to sack them with other fleeces.

Strong or sound fibers are so classed when they are uniform and not weak or tender in any part of their length. Weak portions in a fiber are due to various causes, such as under-nutrition, sickness, exposure, and various other husbandry factors. Wool that has weak spots in any part of its length is generally graded as "clothing," and it may be of a very low grade in this class. In general, better care and housing conditions decrease the percentage of tender or otherwise inferior wool. Sheep that have been exposed for long periods to rough weather on a shortage of feed often have tender or "frozen" wool (Fig. 44). On the other hand, sheep handled in cold, rough country with plenty of feed are known to produce healthier clips than do closely housed flocks.

Frequently wool must be hauled long distances and piled up in the open. Clips carrying a high percentage of moisture sometimes heat under these conditions, and in numerous instances

such heating has injured the wool to the extent of 1 to 2 cents per pound. The injury is often due quite as much to staining, especially when there are tags, as to the weakness reflected in the fiber.

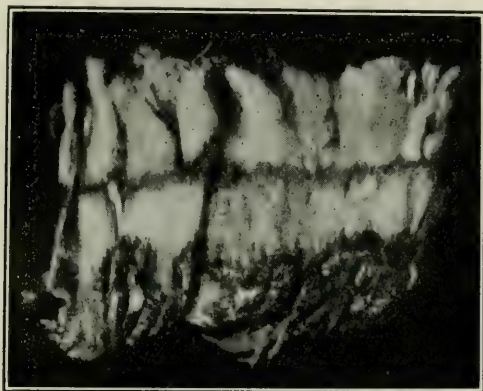


FIG. 44. — TENDER WOOL.

The "break" extends as a distinct line across the staple. Tender wool is usually caused by under-feeding for a time, or by disease.

Retention of Natural Color. — Sheep confined to sheds and corrals often carry wool stained from the manure. Such wool can not be scoured white, hence it must be removed by the wool sorter before rescouring. Stained wool can be used only for the manufacture of dark fabrics and therefore is discounted heavily in price.

SHEARING AND MARKETING WOOL

Shearing with Blade or Machine. — Many years ago when machine shearing was a novelty, there was considerable objection to it. Where weather conditions were variable, machine shearing was objected to because sheep tended to blister during hot weather and chill at night. These objections have been largely overcome, so that most of the large range flocks are machine-shorn. The smaller flocks, especially on farms, are shorn either by machine or by blade (Fig. 45).

Through the use of the machine a band of sheep is shorn more

quickly than when the blade is used, although machine shearing is more expensive. The difference in cost, however, is offset by reducing the cost of boarding the crew, by dismissing extra help sooner, and by getting the sheep back on the range sooner.



FIG. 45. — SHEARING WITH THE BLADES.

Although machine shearing is gaining in popularity, many of the smaller growers resort to blade shearing.

The machine is to be preferred to the blade for tagging because it gets closer to the skin and therefore more effectively prevents the accumulation of inert matter which attracts blowflies.

Shearers should avoid, as far as possible, going over parts of the sheep a second time in order to cut the wool closer to the skin. The short fibers are almost worthless for manufacturing

purposes. The extent to which both machine and blade shearers must make second cuts depends upon the skill of the worker, the general equipment, and the type of sheep being shorn.

Tying Fleece. — The value of wool is frequently lowered by improper tying of the fleece. The use of sisal twine is common, though most growers realize that wool thus tied brings from 1 to 5 cents a pound less than that which is properly bound. Segments of sisal twine adhere to the wool even after it has been through various mechanical cleanings and seriously injure the finished fabric. A paper twine should be used in order to avoid injury to the fleece. The practice of using sisal twine is more common in farm-grown wools than in territory wools.

Weight of Fleece. — The breed of sheep and the section of the country in which the animals are raised bring about variations in the average annual weight of the wool clip.

In the Northwest the average weight is approximately $7\frac{1}{2}$ pounds, whereas in the Southwest the average is about $6\frac{1}{2}$ pounds. In parts of California the average is around 9 pounds. In these areas the wool is clipped from the sheep semi-annually. The extra shearing seems to stimulate the growth of wool.

In the New England and Middle Atlantic States the average clip is close to 6 pounds, whereas in the Middle West the average is over 7 pounds.

Method of Marketing. — Wool is most commonly sold (1) through local buyers, (2) on a commission basis, or (3) through coöperative agencies.

The local buyer purchases wool for speculation or for a wool merchant. He usually acquires customers in a community and buys on a cash basis. If he buys for a wool merchant he works on a commission basis. The local buyer is of value in the handling of small farm clips in case the producer wishes to convert his wool into cash. The wool merchant handles most of the wool grown in this country. For storing the wool he provides warehouses where the wool is graded or otherwise prepared for the manufacturer. As cash is paid for the wool purchased, the wool merchant assumes the risk of lower market values until he disposes of the product. Since the wool merchant must be con-

servative in his estimates of future wool values, growers have felt that they were often underpaid for their wool. Indeed it has been suggested by some wool growers that the wool merchant should be eliminated; but this would be highly undesirable as he occupies an important place in the marketing of wool.

Some wool of the western states is sold on commission. Under this plan the grower consigns his wool to a commission merchant who stores the wool. The grower is kept informed of the prices offered for wool, and his sanction must be obtained before the wool can be sold. The commission man receives a predetermined percentage of the total for making the sale and storing the wool. Under this plan cash for the wool is not available until the sale has been made.

In recent years the coöperative plan of selling has gained in favor. Under this plan a so-called wool pool is organized and its members accumulate as much wool as possible since success is dependent upon the amount of wool that can be accumulated at one point in order to attract competitive buyers. The wool is graded and sold in the original bag and the prices offered are submitted in sealed bids. Several variations of this plan are in use. Generally the grower who sells his wool under the coöperative plan year after year will receive better prices for his crop than if it is sold in any other way. One disadvantage in this plan of marketing, however, is that money is not immediately available for the wool. On the other hand, the coöperative plan of selling wool is proving valuable because of the education it affords in grading. Even though the wool is sold in the original bags, the grower is informed as to the value of his clip and the reasons for the price it brings.

RULES TO BE APPLIED IN MARKETING WOOL

Improvement in the handling of wool in this country, as elsewhere, must come about through understanding on the part of the grower of the demands of the manufacturer. However, there are a number of simple rules which, if followed, are sure

to increase the profits from the wool. Marshall and Heller summarize these as follows:²

1. Breed only the type of sheep suitable to the locality.
2. Lambs', ewes', wethers', bucks', and very oily fleeces, should be sacked separately. If the bucks or part of the ewes or wethers have wool of widely different kind from the remainder of the flock, shear them separately and put the wool in separate sacks so marked.
3. Shear all black sheep at one time, preferably last, and put the wool in separate sacks.
4. Remove and sack separately all tags, and then allow no tag discount upon the clip as a whole.
5. Have slatted floors in the holding pens.
6. Use a smooth, light, and hard-glazed (preferably paper) twine.
7. Knot the string securely on each fleece.
8. Use new sacks each year.
9. Keep the wool dry at all times.
10. Make the brands on the sheep small and do not brand with tar or ordinary paint.
11. Know the grade and value of the wool and price it accordingly.
12. Do not sweat sheep excessively before shearing.
13. Keep the floor sweepings out of the wool.
14. Do not sell the wool before it is fully grown.
15. When all these rules have been carried out place your personal brand or your name upon the bags or bales.

TERMS USED IN WOOL TRADE

In the growing and marketing of wool, and in the manufacture of its products, the following more or less standard trade terms have been developed:

Baby combing. — (See French combing).

Black wool. — Includes any wool that is not white.

Blending. — Mixing two or more lots of sorted grease wool.

Braid wool. — Grade name, and synonym for luster wools.

Britch wool. — Wool from the lower thighs of the sheep; usually the coarsest on the body.

Carbonized wool. — That which has been treated with a solution of aluminum chlorid or sulphuric acid to remove the vegetable matter. Carbonizing is rarely practiced with worsted wools.

² Marshall, F. R., and Heller, L. L., "The Wool Grower and the Wool Trade," U. S. Dept. of Agr. Bul. 206, p. 30, 1915.

Carding wool. — A process in manufacturing by which the wool is carded. Short wools are carded for making woolens.

Carpet wool. — Low-grade, coarse wool used in the manufacture of carpets. There is very little produced in the United States.

Character. — The crimp and life in wool.

Clothing wool. — Wool too short to comb.

Combing. — An operation in worsted manufacture which straightens the fibers and separates the short, weak, and tangled fibers, known as noils, from the continuous strand of long parallel fibers known as top.

Combing wool. — Wool long enough to comb on the English or Noble comb.

Come-back. — In America this refers to a wool fine in quality and having more length than would ordinarily be expected. In Australia it is the result of breeding crossbreds back toward pure Merinos, one of the parents being a pure Merino.

Common. — The sixth of the United States market grades of wool.

Condition. — Refers to the foreign matter present in the wool, particularly the yolk. It largely regulates the price. In scoured wool the term is used to indicate the degree of moisture.

Cotted fleeces. — A cotted fleece is one in which the fibers are matted or tangled. The cause may be ill-health of the sheep or the absence of the proper amounts of yolk or grease in the wool.

Cow tail. — A very coarse fleece, more like hair than wool.

Crimp. — The natural waviness of wool fiber. Uniformity of crimp indicates superior wool.

Crossbred wools. — In the United States the term generally refers to wool from a long-wooled and fine-wooled cross.

Defective. — Denotes that something will show disadvantageously after the wool is scoured. Fire, water, or moths may cause defective wools. California burry wool is quoted as defective.

Delaine wool. — Delaine originally referred to a fine type of women's dress goods. Delaine wools are fine combing or worsted wools, from Ohio and vicinity, but not necessarily from the Delaine Merino.

Fall wool. — Wool shorn in the fall where shearing is practiced twice a year, as in California and Texas. The fall wool is usually dirtier than the spring clip. It represents from four to six months' growth.

Filling (weft). — Threads that run crosswise and fill in between the warp.

Fine. — First of the United States market grades of wool. Wool of small diameter of fiber.

French combing. — Wool too short to comb economically by the English system but of sufficient length to comb by the French system. Baby combing.

Fribs. — Short and dirty locks of small size. Dungy bits of wool.

Frowsy wool. — A lifeless appearing wool with the fibers more or less tangled. The opposite of lofty wool.

Grade. — The average diameter, expressed in arbitrary terms, of the wool fibers in a fleece.

Grease wool. — Wool as it comes from the sheep with the grease still in it.

Half-blood, three-eighths-blood, etc. — The names of official grades of wool.

Hogget wool. — English term for the first wool from a sheep.

Kemp. — Not a dead hair, but an abnormal fiber made up entirely of horny material, such as is on the outside of ordinary wool fiber. It will not dye as well as the ordinary fiber and does not possess spinning qualities.

Locks. — Heavy, dungy bits of wool.

Lofty wool. — Open wool, full of "life." Springs back into normal position after being crushed in the hand.

Long wool. — Wool produced by the long-wooled breeds of sheep.

Luster wool. — That from Lincoln, Leicester, and Cotswold sheep. It is known as luster wool because the coarse fibers reflect the light.

Medium wool. — Wool of medium fineness of fiber.

Noil. — A by-product of worsted manufacture consisting of short and tangled fibers. It is used in the manufacture of woolens.

Off sorts. — The by-product of sorting. In fine staple or any other grade there are certain quantities of short, coarse, stained, and colored wools. These are the off sorts.

Pulled wool. — Wool taken from the skin of a slaughtered sheep's pelt by slipping, sweating, or the use of a depilatory.

Purity. — Absence of fibers other than white.

Quality. — The diameter of the wool. It largely determines the spinning quality.

Run-out fleece. — One that is not uniform but much coarser on the "britch" than elsewhere. It may be kempy.

Sack-burned. — Changed to a permanent bright yellow color by packing too moist. The change may also occur on the sheep's back.

Second cuts. — Short bits of wool resulting from shearing twice over the same area in an effort to clip the wool close to the skin of the sheep.

Seedy. — Wool that contains a liberal quantity of seed or chaff.

Scoured wool. — Wool that has been scoured to remove yolk, dirt, and other impurities.

Shafy wool. — Wool of good length and spinning qualities.

Shearlings. — Short wool pulled from skins of sheep shorn before slaughtering. Also, English term for yearling sheep.

Shivy wool. — A somewhat broad term. It refers to the presence of vegetable matter in the wool.

Shoddy. — Wool that has been previously used for manufacturing purposes, torn apart and made ready to use again.

Shorts. — Small, short bits of wool which fall in the process of sorting the fleece.

Shrinkage. — The loss in weight which grease wool incurs in the process of scouring. Shrinkage is expressed in percentage.

Skirting. — Skirting fleeces consists in removing the pieces and the low-quality wool of the britch from the edge of the fleece.

Sorting. — Separating the fleece into its various manufacturing qualities.

Soundness. — The strength of the wool fiber.

Spinning counts. — Arbitrary numbers, such as 60's, 64's, etc., which denote the fineness of wool. Originally, the figures signified the number of hanks of yarn which could be spun from a pound of top of that particular grade.

Spring wool. — Six to eight months' growth; shorn in the spring where sheep are shorn twice a year.

Stained wool. — That which is discolored by urine, dung, etc.

Staple. — A lock or bunch of wool as it exists in the fleece. Also western combing wool.

Stubble shearing. — Shearing some distance from the skin, leaving a "stubble."

Suint. — Excretions from sweat glands deposited in the wool.

Sweating sheds. — Sheds in which sheep are "sweated" before shearing. The purpose is to raise the yolk and make shearing easier.

Tags. — Large, dungy locks.

Tar. — One of the "off" sorts; made up of wool stained by the paint brands used on the sheep.

Tender. — Lacking in tensile strength; unsound.

Territory wools. — Territory wools are in general those that come from the territory west of the Missouri River.

Tippy wool. — Wool in which the tip or weather end of the fiber is more or less incrustated.

Top. — A continuous untwisted strand of the longer wool fibers straightened by combing. After drawing and spinning it becomes worsted yarn.

Top-maker's qualities or counts. — Top-maker's qualities or counts are the numbers used in designating the quality of certain foreign wools. They range from 12's upward. The numbers are supposed to indicate the number of hanks of yarn that can be spun from a pound of top wool.

Virgin wool. — Wool that has not previously been used in manufacturing.

Warp. — The threads that run lengthwise in cloth.

Wether. — In English wools it refers to wool other than the first clip from the sheep. In sheep, a castrated male.

Woolen. — Fabrics made from uncombed wool.

Worsted. — Fabrics made from combed wool.

Yolk. — The fatty grease deposited upon the wool fibers from the oil glands.

QUESTIONS

1. (a) What part of the world's wool supply is produced in the United States? (b) In Australia and New Zealand?
2. (a) Discuss wool as an article of commerce. (b) Discuss wool substitutes:
3. How many pounds of wool (1) in the grease and (2) on a scoured basis, are required in the manufacture of 1 pound of worsted cloth of average weight?
4. (a) Discuss the structure and properties of a wool fiber. (b) How does the structure of wool differ from that of hair?
5. (a) Name and discuss the requisites of good wool. (b) How are wools classed?
6. (a) On what basis are wools graded? (b) What is meant by domestic wools? Territory wools? (c) What is meant by quarter-blood wool? Braid?
7. May wool be graded safely according to breed of sheep?
8. State the merits of hand and machine shearing, respectively.
9. What kind of twine should be used in tying the fleece?
10. Discuss the ways in which the producer may increase his returns from the wool.

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CHAPTER XI

COMMON DISEASES OF SHEEP AND THEIR CONTROL

Sheep are susceptible to a number of diseases, particularly to attacks by parasites, and suffer more severely from this cause than any other class of domestic livestock. The toll caused by parasites is the more evident because sheep, unlike cattle, are little subject to serious bacterial plagues or virus diseases. Tuberculosis, for instance, is practically unknown in sheep, yet the mortality — due almost wholly to ravages by parasites — averages fully as high as do deaths in cattle chargeable to all classes of disease.

Generally the damage from parasites is greatest among lambs and young animals. The flockmaster should make a serious effort to suppress parasitic diseases and especially to prevent infection. This he can usually do successfully if he is familiar with the life history of a few of the more important parasitic organisms, knows how the animals become infected, and will apply a few simple precautions.

STOMACH WORMS

The stomach-worm disease has been, and still is, the cause of large losses in sheep.

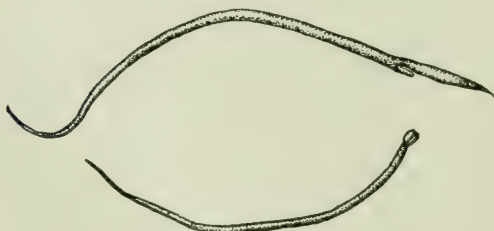


FIG. 46. — STOMACH WORM.

Upper figure, female; lower, male. Magnified three and one-half times.

It is often a serious ailment with young sheep and is usually more prevalent in seasons which are abnormally wet than in dry years.

A brownish-colored thread worm, *Strongylus contortus* by name, is the cause of the ailment (Fig. 46). These small worms

live in the alimentary tract of a sheep, principally in the fourth stomach. They injure the animal by consuming blood and by secreting a poisonous fluid which destroys the red blood corpuscles. Adult sheep may withstand the worms, but the injury is often fatal to lambs.¹

Symptoms. — Dullness and lack of thrift are the first indications of the presence of stomach worms. Sometimes the animal dies before the owner is aware of any trouble, the emaciation having gone unnoticed because of the wool. When the progress of the disease is slow the wool on the animal is shredded and pulls out easily. The victim grows progressively weaker until he is easily pushed over by the other sheep and then finds difficulty in rising again. The animal's skin has a pale and bloodless appearance and there may be a watery swelling under the jaws. A reliable diagnosis can be made by killing the sheep and examining the fourth stomach for worms, which are from $\frac{1}{2}$ to $1\frac{1}{4}$ inches long and the size of a pin. Their movement is snakelike.

The stomach worm lays its eggs in the sheep's stomach. These eggs are passed out with the feces and hatch on the ground. The young worms, after hatching, climb up on grass blades and are taken by the sheep into their stomachs with their food.

Prevention and Treatment. — It is more satisfactory and economical to prevent the stomach-worm disease than it is to treat it after it gains a foothold in a flock. The most effective preventive measures are as follows: Plan to have lambs dropped early and feed to develop them as much as possible before they go on pasture. Rotate the pastures. This can best be done by dividing the paddock into five or more compartments, provided water facilities will permit. Neither ewes nor lambs should be kept on any one division more than two weeks at a time, and the lambs should not be returned to land that has not been plowed since it was grazed by sheep. While this system is somewhat expensive, it is practically proof against losses from stomach worms. Moreover, rotation grazing, by changing of pastures, is especially commendable when the fertility of the land is in

¹ Ransom, B. H., "Stomach Worms in Sheep." U. S. Dept. of Agr., Farmers' Bul. 1017, 1918.

need of improvement and the grazing capacity is low. When properly carried out this system has proved profitable where 50 or more ewes are run.

Where sufficient changes of pasture can not be provided, segregate all suspected cases and keep all food away from them for about twenty-four hours. Make a drench by dissolving $\frac{1}{4}$ pound of powdered bluestone in a pint of boiling water and add sufficient cold water to make a total of 3 gallons of solution. The dose for an adult sheep is $3\frac{1}{2}$ fluid ounces. For lambs under a year old, $1\frac{3}{4}$ fluid ounces of the solution is sufficient. Some shepherds dose all ewes before turning them out to pasture with their lambs, and dose all the lambs that are to be kept after weaning time. This precaution will keep the infection among the lambs down to a minimum.

Care is necessary in drenching, as improper dosing may cause serious damage. While the lambs are with the ewes, change pasture every two weeks if possible, as pointed out, and do not return the flock to the old pastures until the lambs are marketed. Practically all the worms will disappear from a pasture in a year if sheep or other susceptible ruminating animals are kept off it.

LIP-AND-LEG ULCERATION

Lip-and-leg ulceration — called by the general term, *necrobacillosis* — is an infectious sheep disease. It is characterized by the formation of pustules on the skin which cause rapid destruction of tissue. In all its various forms it is highly infectious.

Lip-and-leg ulceration has been observed in various parts of this country and in Europe since about 1890. Little effort was made to find its cause or to check its spread, however, until about 1910, when the germ was isolated and a campaign to eradicate it undertaken. The most severe outbreaks of the lip-and-leg disease in the past have been in the Northwest, especially during the winter season.

The losses vary in the different states, ranging from 10 to 30 per cent in some infected bands, to an insignificant percentage in others which have had only a mild attack.

Nature of the Disease. — Lip-and-leg ulceration, besides being an infectious disease, also belongs to what are called inoculation diseases. The germ gains entrance to the body through impaired or broken tissue. Frosted herbage, hard "wiregrass," and certain other feeds will produce wounds into which the bacillus may enter and cause disease.

As cuts and bruises are not frequent on the parts of the animal which are covered with wool, it follows that the lesions are usually found on the other parts. The lips, chin, nose, cheeks, gums, and hard palate are most liable to lesions in this country, although ulcers are also found on the legs and feet, in shear cuts, and in the tail stump of docked lambs. The genital organs of both sexes are sometimes attacked.

Lip-and-leg ulceration may assume either the active or the inactive stage. In the active form there is inflammation, tumefaction, ulceration, and necrosis with or without scab formation. Sometimes parts of the lips or the end of the nose may slough entirely away. The appetite of the animal usually remains good, although it feeds with difficulty owing to the tenderness of the affected parts. With foot or leg lesions the animal may become lame. The inflammation rapidly penetrates beneath the horny tissue and a discharge with a disagreeable odor exudes (Fig. 47).



FIG. 47. — LIP-AND-LEG ULCERATIONS.

The disease usually manifests itself quite generally in a band, attacking alike both young and old, male and female.

Certain types of vegetation within a locality seem to foster the disease germ. Prolonged drought which renders food scarce and

induces the sheep to browse on thistles and similar roughage tends to increase the spread of the disease. After rains the disease is often checked and the animals recover rapidly.

Besides infections caused by mechanically injurious or frozen forage, this organism may gain a foothold in wounds where the hair and skin are pulled off the sheep by dried mud, and by the tissues becoming devitalized by frost bites.

Prevention and Treatment. — Prevention is the most important means of keeping a band clean, but in treatment lies the only means of making a diseased band healthy.

If the flock is clean, new blood to be introduced into the herd should be in quarantine for two weeks. If the disease does not make its appearance in that time, the new sheep can safely be turned in with the clean band. Careful examination should be made of all sheep, especially breeding animals, and any animal showing any symptom of the disease should be separated from the rest and carefully treated.

Besides separating the sick from the well, and scrutinizing closely the rest which have been exposed, there should be complete disinfection of pens, corrals, and sheds, as the disease germ will retain virulence under favorable conditions for several years. The racks, walls, and troughs should be sprinkled with a 5 per cent solution of standard sheep dip or some other reliable disinfectant, and the surface soil of the corral should be removed and the ground sprinkled with the disinfectant.

The healthy sheep should be taken to new and uninfected grounds and pastures. Some lands that have been occupied by flocks suffering from lip-and-leg ulceration are free from the germ after a winter's frosts have intervened.

The essential treatment is disinfection and cleanliness. In treating infected sheep the principal requisite is to expose properly the affected surfaces so that the applied remedy may destroy the infectious matter. Local antiseptics are satisfactory if their use is begun in time and applied energetically.

"In mild, unadvanced cases of lip-and-leg ulceration, the best results are obtained by removing entirely the scabs and shreds of tissue from the diseased areas by means of a piece of wood sharpened to a proper angle and

applying three or four times weekly a solution of one of the cresol or coal-tar dips, or what is far better, an emolient dressing containing 5 parts of one of these dips, 10 parts of sublimed sulphur, and 100 parts of mutton tallow, vaseline, or lard. This form of the disease responds quickly to any of the common antiseptic solutions and it is astonishing how speedily the majority of these cases improve after careful hand treatment."²

In actively progressive cases or in aggravated chronic forms it is desirable to remove the scabs, scrape all the soft, spongy tissue from the ulcers, and touch the affected area with a 10 per cent solution of zinc chlorid or nitric acid in the strength of 1 part to 7 parts of water. As these solutions are penetrating and extremely caustic in the above strength, they should be handled very carefully and applied to the diseased parts only.

The majority of severe and chronic cases may be cured in four or five weeks of this treatment, but when the number of old cases in a band is small, it is cheaper to destroy the victims than to treat them.

The problem on the range is difficult when large numbers become affected, all requiring hand treatment. When a large number have the ulcers on the legs and feet, the best treatment is to have the sheep pass three times a week through a trough containing a 5 per cent solution of some reliable coal tar disinfectant. Care must be taken to see that the affected places are in direct contact with the fluid. The bad cases must be hand-treated. After sheep which are affected have received local treatment and have recovered, they should be dipped with a disinfectant before they are turned into uninfected pasture. Sheep with any traces of the disease should not be shipped to non-infected territory.

SCABIES OR SHEEP SCAB

A few years ago scabies was the most serious handicap with which the sheep industry in this country had to contend. Now, through quarantine and other methods of control, it has been reduced until the economic loss from scabies is very small.

² Mohler, John R., "Lip-and-Leg Ulceration of Sheep: Its Causes and Treatment." U. S. Dept. of Agr., Bur. Animal Ind. Cir. 160, p. 21, 1910.

Sheep scab is caused by a small parasite which lives in the skin of the sheep. The disease is not hereditary, but a diseased ewe may infect her lamb shortly after its birth.

In flocks where sheep scab is allowed to spread, great financial loss is caused by their death. In addition, there is a large indirect loss caused by the depreciation in weight and loss in vigor of the animals that survive. The amount both of wool and mutton produced by scabby sheep is small compared with that produced by healthy animals.

Scabies is extremely contagious and severe in its effects in most cases, but it is easily cured when properly treated. The

system of grazing practiced on the open ranges in the West is of such a nature, however, as to make it very difficult to keep a band free from scab.

Nature of the Disease.—

The small sheep scab mite (*Psoroptes ovis*) (Fig. 48) is the cause of the disease. It can be seen by the naked eye if placed on a dark background. Mites may be found on any part of the sheep which is covered with wool, but the largest numbers are found where the wool is thickest. The scab mite pricks the tender skin of the sheep to obtain the blood and in so

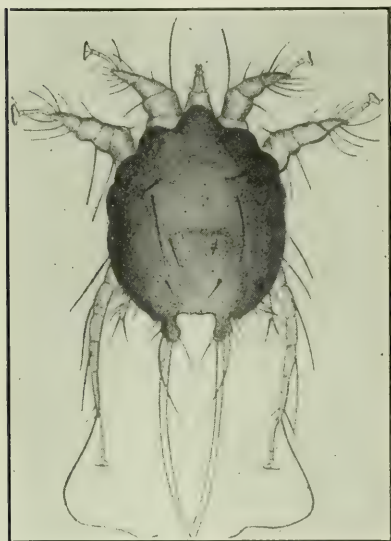


FIG. 48.—SMALL SHEEP SCAB MITE.

Male, dorsal view, much enlarged.

doing probably introduces a poisonous saliva into the wound. A slight inflammation follows but the first of these small swellings are seldom observed. As their numbers multiply, however, the serum which oozes to the surface becomes mixed with dirt and other inert matter and forms a scab. These scabs at first are yellowish but later they become dark-colored. Affected

portions of the skin become thick and hard as the disease progresses.

The irritation causes the sheep to be restless; they bite and scratch themselves and pull out more or less wool. When the disease has reached an advanced stage, the skin becomes nearly denuded of wool (Fig. 49). If not treated, the animals die.



FIG. 49.—SKIN DENUDED BY ADVANCED STAGES OF SCAB.

If the animal is not treated it dies.

How Sheep Scab is Spread. — Scabies in sheep is very easily spread. It is transmitted by direct contact with infected animals or with any object that may carry the mites. The disease spreads rapidly through a flock. Tags of wool, posts against which sheep have rubbed, roads, trails, sheds, yards, pastures, and ranges are all common carriers of the parasite. These mites do not propagate except on sheep, but they will live for a long time on other animals, particularly goats.

The symptoms may develop in a week after an animal is infected, but in some cases they do not appear for several weeks. Scab does not develop as rapidly in hot weather as when the temperature is low. The fine-wooled breeds suffer more from infestations of the scab mite than do the coarse-wooled sheep, as they succumb more quickly. After shearing, the scabs on any breed of sheep dry up and apparently heal. The infection is not destroyed, however, but only becomes dormant, ready to break out at any time. Often the infection is spread by the placing of the rams in a "public buck" herd. Therefore, it is always best to dip the bucks at least once before they are returned to their owners or admitted to the ewe band.

Prevention and Treatment. — Immunity is not secured by attacks of scab, for sheep may become infected any number of times. The only treatment for scab which will effect a cure is proper dipping.

The usual method of dipping is to have the sheep swim through a vat which is filled with a medicated solution that will kill the parasites. Two dippings, ten to fourteen days apart, are necessary to effect a cure.

In localities where scabies is prevalent, all the flock should be dipped whether every individual shows symptoms of scab or not. The ewes and lambs should be separated and dipped at separate times. Dipping should be done during the warm part of the day to prevent the animals from chilling.

The lime-and-sulphur dip has been used more than any other in the work of eradicating scab. The well-tested formula for lime-sulphur dip is as follows: Eight pounds of unslaked lime; 24 pounds of flowers of sulphur; 100 gallons of water. To prepare this mixture the lime is slaked in a little water and the sulphur is added slowly. Stir constantly while adding it. Transfer this mixture to a vessel containing 30 gallons of hot water and boil for two hours. Care must be taken to keep the mixture stirred so that the material will not stick to the bottom of the kettle, and water must be added from time to time as it boils away. The boiling together of the two chemicals results in

calcium sulphide which is the active agent in the dip which destroys the mites.

After the boiling, the chocolate-colored mass is placed in a barrel. When it has settled for several hours, the clear solution may be dipped from the top of the barrel. What is left is uncombined lime and sulphur. If this is used in the dip it will injure the wool. Warm water should be added to the clear solution to make up 100 gallons. The temperature of the dip after mixing should be from 100 to 105 degrees Fahr.

Nicotin and sulphur dip is also recommended. It is made with sufficient nicotin solution and flowers of sulphur to give a mixture containing not less than 0.05 per cent nicotin and 2 per cent sulphur. Sufficient nicotin for 96 gallons (about 800 pounds) of dip would therefore be furnished by one pound of a 40 per cent solution of nicotin. The formula for this dip would be: Nicotin, 0.4 pound; flowers of sulphur, 16 pounds; water, 96 gallons.

"To calculate how much nicotin solution should be used for 96 gallons of water, divide the quantity of nicotin required in the dip by the proportion of nicotin in the product. For example, suppose the nicotin solution contains 25 per cent nicotin, we have $0.40 \div 0.25 = 1.6$. Therefore in this case it would require 1.6 pounds of nicotin solution for the 96 gallons of dip. No nicotin preparation the strength of which is not given on the outside of the package should be used.

"In preparing these dips, the nicotin solution and sulphur should be mixed together with water before adding them to water in the dipping vat. The dip should on no account be heated above 110 degrees Fahr. after the nicotin solution is added, as heat is likely to evaporate the nicotin and weaken the dip."³

There are many manufactured dips for sheep scab on the market, which are efficient and reliable.

³ Imes, Marion, "Sheep Scab." U. S. Dept. of Agr., Farmers' Bul. 713, p. 26, 1916.

ANTHRAX

Anthrax, known also as splenic fever and charbon, is an infectious disease which affects animals and occasionally man. It is variously known as anthrax, charbon, splenic fever, or splenic apoplexy when it occurs in animals, and as malignant carbuncle or woolsorter's disease in man.

None of the domestic animals are exempt from anthrax, but sheep and cattle are the most susceptible. In man, the disease ordinarily is less virulent than in domestic animals.

The first recorded outbreak of anthrax occurred early in the seventeenth century among the cattle herds of southern Europe. From the domestic animals it spread to the people and became a scourge, causing a total of 60,000 deaths before it ran its course.

Nature and Symptoms of the Disease. — Anthrax is caused by a cylindrical or rodlike germ called *Anthrax bacillus*. It multiplies rapidly in the body, especially in the blood, and produces poisonous substances which cause death. The anthrax virus thrives best under certain conditions of the soil and on land subject to floods. Black humus and swampy soils are common sources of infection, as are fields with stagnant pools in them. The disease may be limited to certain farms where soils favorable to the germ occur, or to certain soil types on a farm.

There are three forms of anthrax: the highly acute, the moderately acute, and the subacute.

The *highly acute* form is accompanied by sudden death. The animal, without having shown any particular signs of distress in the evening, may be dead in the morning. The characteristic symptoms of this type of the disease are a high temperature (around 104 to 106 degrees), a rapid and audible pulse, and a labored respiration. Often there is an attendant grinding of the teeth and shaking of the whole body. In a few hours the animal becomes stupid, sleepy, and weak in the hind quarters. As the disease progresses the temperature drops until just before death, when it is subnormal. With this form, sometimes, before any symptoms are observed, the animal drops suddenly in the pasture and dies in convulsions.

The *moderately acute* form is the most common in cattle. It is characterized by a high temperature and a rapid pulse in the beginning of the attack, and the animal does not eat or ruminate. Chills and tremors appear and the ears and base of the horns are cold. As the disease progresses, the animal becomes dull, stupid, and very weak. There are spasms of the limbs, and the animal kicks and paws the ground. Breathing becomes more labored, with the nostrils dilated, and all the muscles of the chest are strained. The visible mucous membranes turn a bluish color. The blood vessels may rupture, and the urine and discharges from the bowels frequently contain blood. Death usually occurs in one or two days.

The *subacute* form is similar to the moderately acute type, but is slower in development. The temperature is high, and local anthrax tumors appear externally, usually on the neck, head, and shoulders. This form of the disease requires from one to seven days for its development. An examination of the carcass usually shows hemorrhages in almost all parts of the body. The subacute type is the only form that responds to treatment.

The chief distinction between anthrax and blackleg is that the anthrax tumors do not crackle under pressure as do the blackleg tumors, but have a somewhat doughy consistency. The spleen after a blackleg attack is not swollen and dark as it is in the anthrax cases. Anthrax and Texas or tick fever differ in two respects. In the former, the attack develops more quickly and the blood is dark and thick, while in the latter it is thinner than normal.

Prevention and Treatment.—Animals that run on low, mucky lands are the most common victims of the disease, but hilly pastures that contain wet, low places may harbor the germ. In pastures with but little lowland the disease may be controlled if the low places are fenced against stock. How long these spots remain dangerous is a mooted question. The germ may remain active in some soils for years. Carcasses of animals, even if buried deep, retain infectious germs which will multiply for years. In stagnant water the germs are known to flourish for twelve months.

Vaccination against the disease is a popular method of prevention, especially in cattle, both a vaccine and a serum being used. The vaccine is injected into one side of the animal and the serum into the other. The animal is rendered immune as soon as vaccinated and this method necessitates only one handling.

All anthrax carcasses should be burned. No dead animal having had the disease should be skinned or cut open, as this is a dangerous way of spreading the infection. The discharges from the body should also be burned, and every place contaminated should be disinfected. Where burning is impracticable, the carcasses should be very deeply buried and covered with quicklime.

LIVER FLUKE

Liver fluke is the name applied to a common disease of sheep, caused by a trematode worm (*Fasciola hepatica*). In some localities the disease is troublesome in sheep during wet weather, but it is most prevalent in flocks that graze upon poorly drained lands.

Nature and Symptoms of the Disease. — The fluke worm lives in the biliary ducts of the sheep and feeds on the bile, which is imbibed by means of a sucker. The organism in the sheep's liver is a brown, flattened, leaflike organism, oval in shape, being generally less than an inch in length and about half an inch in width. Large numbers of fluke worms of different sizes are found in a badly infested sheep's liver. The organism does not multiply there, but the eggs are laid in the liver. The eggs pass out, apparently with the bile, and are deposited with the feces. In moderately warm weather the eggs hatch in a few weeks. The larva, which is microscopic and covered with organs of locomotion, swims about vigorously in water. It has a boring apparatus and soon it becomes attached to a snail which it penetrates. In this host the body changes materially, finally assuming a cylindrical form which can be seen with the naked eye. At this stage it leaves the snail host, swims about for a while, and in time attaches itself to vegetation, from which it lodges in the sheep's stomach. The parasite, transformed somewhat

in the stomach, apparently finds its way to the liver through the bile duct.

This parasite occurs over a large part of the world in low, wet lands, such as along rivers, and tributary streams, where the snail host is found. In the United States it is distributed from the Atlantic to the Pacific Coast, and along the Gulf of Mexico. The most severe cases occur in Florida, Alabama, Texas, Arkansas, Louisiana, California, Oregon, and Washington.

Prevention and Treatment. — Three forms of control have been used: (1) medical treatment of the animals affected; (2) destruction of the embryos and larvae of the fluke by treatment of the soil; and (3) destruction of the snail host by treatment of the water.

Powdered kamala, to be administered by a veterinarian, is the best remedy for fluke-sick sheep. To yearlings and mature sheep give two doses of 7.5 grams (2 drams) each from twelve to twenty-four hours apart.

Dressings of lime and salt in the summer are used for killing the embryos and larvae of the fluke and for killing and repelling the snails. After such treatment of the pasture, the manure from infested sheep should not be put on the land, especially on wet ground.

The treatment of stagnant or running water to destroy the snail may be accomplished by using copper sulphate (bluestone) at a strength to make one part to a million. (First determine the volume of the water and then add one ounce of copper sulphate to 7800 gallons of water.) This will kill snails in forty-eight hours, but it will not kill the eggs. Repeat this treatment in from two to three months, after the eggs hatch. The solution is not injurious to the higher plants or animals, or for drinking and bathing. It is best, however, to keep the sheep entirely away from fluke-infested land.

SCREW-WORM AND OTHER MAGGOTS

Screw-worm. — The screw-worm is the larva of a fly, or dipterous insect, which attacks mammals and sometimes man. It inhabits all of the tropical and much of the temperate region.

In the United States the most serious trouble to livestock occurs in Texas, New Mexico, Arizona, Oklahoma, and southern California.

Nature and Symptoms of the Disease. — The adult fly is of a metallic, bluish-green color, with three black stripes on the thorax. It is active in the summer and lays a great many eggs in decaying matter or in an open wound of an animal. Cases are on record where eggs have been deposited in the nostrils of catarrhal persons while they were sleeping out of doors. The

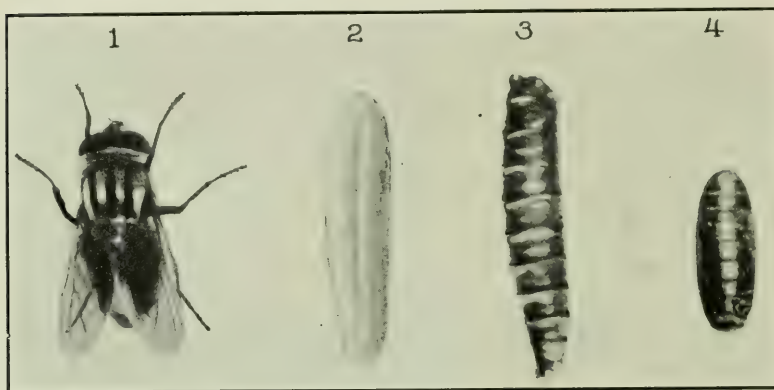


FIG. 50. — 1, SCREW-WORM FLY. 2, EGG OF SCREW-WORM. 3, SCREW-WORM MAGGOT. 4, PUPA, OR RESTING STAGE, OF SCREW-WORM. ENLARGED.

eggs may hatch in an hour. The active, whitish, footless maggots, or larvae, burrow into the tissues, causing untold agony. Losses in livestock are heaviest among young calves and colts, and to a lesser extent among sheep, but carnivores of all kinds are also subject to severe attacks. Young deer and other small mammals are sometimes seriously infested. The larva grows rapidly, matures in a few days, and then leaves the wound to be transformed to the pupa. The cycle of development is rapid and there may be several generations in the course of a summer (Fig. 50).

Other Maggots. — Various species of flies infest wounds of livestock and other mammals, and among sheep the wool-maggot is seriously troublesome. Some of the flies that infest

sheep have less tendency to attack wounds that are fresh than those that are foul. A common point of infection in sheep is about the rump after lambing. Some of the sheep die from the infection; all are weakened, and the loss in wool often amounts to half of the normal clip. The maggot feeds near the skin, thereby loosening the wool and causing it to drop off. The worst trouble-maker among sheep in the Southwest is the black blowfly (Fig. 51-A). It also is active in wounds of cattle following dehorning. This fly operates during warm weather in winter and in autumn and multiplies rapidly in the spring, but it is comparatively inactive in the summer at the time that the screw-worm is most abundant and aggressive.

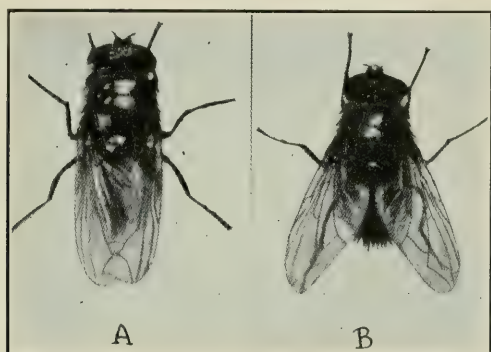


FIG. 51. — A, BLACK BLOWFLY OR COMMON WOOL-MAGGOT FLY. B, GREEN-BOTTLE FLY OR GREEN BLOWFLY.

The green-bottle fly or green blowfly (Fig. 51-B) is also troublesome in this country, but it is not as commonly found on the range as the screw-worm fly and the black blowfly. Occasionally it deposits eggs on the soiled rumps of calves and sheep, and sometimes it infests wounds of wild animals. In the British Isles the green-bottle fly is the insect that causes the serious wool-maggot disease.

Prevention and Treatment of Maggots. — It is important to prevent maggot infection in livestock at the time of branding, marking, and castrating. Select for this work periods of cool weather. To prevent maggots from finding lodgment in wounds,

apply pine tar. Infected wounds should be sponged with a carbolic acid wash of 1 part carbolic acid to 30 parts of water, after which a coating of glycerin or pine tar should be applied. For the screw-worm, nothing is better than treating the wounds with chloroform, followed with pine tar.

It is well to have the calves and colts dropped before the screw-worm pest becomes active. The tails of lambs are sometimes infected by maggots following docking. This can be largely prevented by removing the tails with the more approved form of searing iron. Moreover, it is advisable to breed hornless sheep where maggots are bad; to lamb as early in the spring as possible; and to shear so that the band will have a minimum amount of wool during warm, humid weather.

Where death ensues the carcass should be destroyed, preferably by burning.

MINOR SHEEP DISEASES

Non-Infectious Foot Rot. — When a lame sheep is noticed in a flock, it should be examined carefully to determine the cause of the lameness. If a number of sheep suddenly become lame at one time, the trouble is usually non-contagious foot rot, also called "foul-in-the-foot."

Simple or non-contagious foot rot is caused by wading in mud, grit, or filth, or by the lodging of some foreign substance between the toes. In wet seasons, flocks on low pastures are apt to have this form of foot rot.

With this type of foot rot, the canal of the gland that supplies lubricant becomes blocked and pus forms. This gland is located in the hoof head, directly above the separation of the toes. If the trouble is severe, it is well to suspect contagious foot rot, that is, lip-and-leg ulcerations.

The loose and rotting hoof horn should be cut off in a way that will cause as little bleeding as possible. When the foot has been freed from the diseased horn, it should be soaked in a disinfectant. A 2 per cent coal-tar solution is good for the purpose. Place saturated cotton batting or oakum over the wound and saturate it with the disinfectant solution. The cotton can be

held in place with a narrow bandage that is passed between the toes and wound several times around the pastern. This dressing must be renewed daily. If an abscess has formed, cut to liberate the pus and carefully cleanse the canal with swabs wet with tincture of iodine, before applying the dressing, which has been saturated with coal-tar solution.

Bighead. — This disease in sheep is a condition affecting principally the head and ears, causing them to swell to enormous proportions.

The greatest losses from this disease in the past have occurred in southern and central Utah, southern Idaho, eastern Nevada, and western and southern Wyoming. This disease does not seem to be known in foreign countries, although buckwheat poisoning, the results of which are somewhat similar to bighead, is found in Europe.

Bighead is not contagious or infectious. All experimental efforts to make healthy sheep contract the disease from those affected with it have failed. Young lambs seldom have the disease, but it affects both male and female adult sheep. The disease seems to be most prevalent on warm days preceded by cold and stormy nights, especially when the band is driven rapidly over a trail.

The affected animal at first constantly throws its head up and sidewise, shakes it, and tries to rub it. The bighead victim seldom stands still and frequently bumps into other sheep and objects as if its eyesight were affected. Soon the animal commences to jerk its head, and the ears and cheeks begin to turn red and enlarge. Later they assume enormous proportions. In the last stages light yellow serum exudes from the swellings. In some cases the tongue swells so that it completely fills the mouth. The eyes are usually swollen shut. Some of the animals affected with the disease die, while others recover, but they never again reach the pink of condition.

If sheep are handled properly — not driven too far or too fast on the trail during the heat, especially before shearing in the spring — bighead is seldom in evidence. Frederick⁴ recommends

⁴ Frederick, H. J., "Bighead in Sheep." U. S. Dept. of Agr., Bur. of Animal Ind., Cir. of May 24, 1914.

that sheep when affected should be allowed to rest for twelve to twenty-four hours and have their heads anointed with olive oil or vaseline. They will usually then recover completely. When the band is on the trail and an animal develops a case of bighead, the sheep should not be rushed over the ground but should be allowed to rest.

Bloat. — Bloating is less common in sheep than in cattle, but when it occurs in a flock a number of animals are usually affected. Late summer and early fall are the seasons in which bloating is most prevalent.

The most common cause of bloating is overeating of succulent or frozen foods, such as rape, alfalfa, clover, green corn, etc., especially when such feed is wet with dew or light rain. If the rumen is diseased, bloating or acute tympanites may become chronic.

In a bloated animal the left flank is distended first, but as the gas forms the whole abdomen becomes swollen. When the trouble commences, the sheep stops eating and looks anxious. The abdomen, if tapped with the fingers, gives a resonant sound, the mucous membranes become congested, the eyes prominent, saliva dribbles from the mouth, and the feces are discharged at irregular intervals. Breathing becomes labored, the pulse is weak, and if the animal is not relieved it becomes stupid, sinks to the ground, and dies. Death is caused by the absorption of a toxic product from the stomach by the blood vessels and from the rumen pressing against the lungs when it is distended, thus preventing aëration of the blood.

In severe cases the rumen should be punctured with a trocar and canula, as in the treatment of cattle. The most prominent portion of the left flank is the seat of the operation. A small-sized trocar should be used, and it should be carefully sterilized in boiling water before being inserted.

If many sheep are affected and if there is a stream in the pasture, driving them into the cold water sometimes effects a cure. Movement in the rumen is stimulated by the cold water and the gas works off naturally. Dipping in cold water has much the same effect.

A tablespoonful of turpentine in 3 or 4 ounces of linseed oil may be given to prevent further fermentation. Musty grains, fodders, roots, and frosted foods should not be fed to sheep, and the band should be changed from a dry to a succulent diet very gradually. Do not allow a flock to graze ravenously on any highly palatable succulent food that is wet with dew or light rain.

Diarrhea. — Many young lambs are troubled with diarrhea. A weak constitution and unhygienic quarters will often cause this disease, but the most common cause is too much milk and variation in its character. It may also be contracted through the umbilical cord becoming infected with the contagious element.

The lamb that is troubled with diarrhea refuses to suckle and is dull and depressed. The abdomen becomes distended if fermentation takes place, and the animal shows evidences of pain. Constipation sometimes precedes the diarrhea. The discharge is foul smelling, and the tail, hips, and legs soon become soiled. The animal becomes feverish, although its extremities are cold, and it grows weak and emaciated, and may die. When the disease is of the infectious type, a large number of lambs are usually lost in flocks where it is rife.

Prevention is easier than cure with this disease, as with many others. Lambs should always be given dry, clean quarters with room for plenty of exercise. When the mother's milk does not agree with her offspring, her ration or general management should be changed at once.

A laxative consisting of 2 drams of castor oil may be given the lamb, followed by 5 to 10 drops of laudanum three times a day. If there is much fermentation, $\frac{1}{2}$ dram of calomel and 6 drams of chalk may be mixed and 1 teaspoonful given the lamb three times a day in milk. The lamb should be dieted until the trouble abates.

Gid. — The disease known as gid affects the brain of sheep and causes heavy losses in herds where it is prevalent. New York, Ohio, Illinois, Iowa, Michigan, Missouri, Kansas, Indian Territory, Nevada, and Montana have all reported animals dying from gid. Montana has suffered most from outbreaks of this disease. The infected area there is about 400 miles long and in

places 200 miles wide. Cases occur outside this area but the animals have usually been found to have come from this infected northern range.

The losses from gid in Montana in some years have been at least \$10,000 and this amount is bound to increase unless strict preventive measures are taken.

Gid is caused by the larval tapeworm parasite (*Multiceps multiceps*) which occurs as what is known in zoölogy as a bladderworm in the brain of sheep. This parasite is transmitted to dogs and other canines by their eating the heads of sheep which have died from gid. In the intestines of the dog, bladderworms develop into tapeworms. The eggs formed by the tapeworms are passed on to the range and taken up by the sheep in their food and water. From the eggs an embryo gets to the brain of the sheep and forms a bladderworm.

The first symptoms of gid are slight fever and restlessness which occur when the embryo reaches the brain of the sheep and begins to travel. The lesion may be severe enough at this point to kill the animal, but usually after this period there is no further indication of disease until the head forms on the bladderworm. Then the irritating action on the sheep's brain of the bladderworm's head, with its crown of hooks, causes the animal to run, jump, or walk in a circle. In the latter stages of gid, which do not occur until seven or eight months after the sheep is affected, it is blind, carries its head on one side, and stops eating some days before it dies.

In the past many cases of gid have been diagnosed as loco-poisoning, but the symptoms are different in many respects: Locoed sheep do not show the regular automatic repetition of some unusual movement such as giddy sheep show; and if put on alfalfa locoed sheep nearly always recover, whereas giddy sheep do not. Killing one of the affected sheep and examining its brain provides the most positive proof, however. The developed gid parasite is large and is found in a sac full of fluid. It is easily located.

The first method of prevention consists in destroying the heads and brains of all sheep which die of gid. The second way is to

keep all dogs on the range free from this tapeworm. This can be accomplished by administering tapeworm medicines, which are put up in convenient form.

The sheeps' heads should be destroyed by burning or by splitting the skulls, scooping out the brains, chopping or crushing them, and covering with turpentine, formaldehyde, or sheep dip. Some of the most favorable cases can be successfully operated on. Care should be taken to destroy the parasite when it is removed by an operation. When the outbreak of gid is over, tapeworm remedies should be administered to the dogs at least once a year.

QUESTIONS

1. (a) Is the stomach worm the cause of as heavy losses in lambs as in mature sheep? (b) Discuss the life history of the stomach worm. (c) What are the symptoms of sheep infested with stomach worms? (d) Discuss the pasture rotation system recommended to control losses from the stomach-worm disease. (e) What medical treatment should be given to cure sheep infected with the disease?

2. (a) What is the nature of lip-and-leg ulceration, both in the active and the inactive stages? (b) How is lip-and-leg ulceration spread and how may the disease be controlled? (c) Discuss the treatment recommended for the cure of sheep infested with lip-and-leg ulceration.

3. (a) In what states has bighead in sheep occurred in the past? (b) What is the cause of bighead? (c) Discuss the nature, treatment, and cure of bighead.

4. (a) Compare the losses caused by scabies in sheep in the past with present losses. (b) What is the cause of sheep scab and how does it affect the animal? (c) How is sheep scab spread, and how soon after infection do the symptoms develop? (d) Discuss methods of prevention and treatment of sheep scab.

5. Discuss the cause and treatment of non-infectious foot rot.

6. (a) Is anthrax the cause of heavy losses in sheep? In cattle? (b) Discuss the treatment and prevention of anthrax in livestock generally.

7. Discuss the causes and treatment of bloat in sheep.

8. (a) What are some of the common causes of diarrhea in lambs? (b) What treatment is recommended?

9. (a) What is the cause of gid in sheep, and how may this disease be recognized? (b) In what states has gid been most prevalent? (c) Discuss the prevention and cure of gid.

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CHAPTER XII

RAISING GOATS ON RANGE AND FARM

Various breeds of milk goats, and the all-important Angora, are raised in this country; and although the Angora, or range goat, is the subject of discussion in this chapter, the husbandry in general applies also to other breeds.

The native habitat of Angora goats is Angora, in Asia Minor. They have been raised in that country for many centuries. The two largest centers of the mohair industry today are in Angora and South Africa. Both countries many years ago passed laws prohibiting exportation of goats, but America had already obtained some of the best blood before these edicts went into effect. Today there are Angoras in the United States that are as good as those grown in any other place in the world.

The first Angoras were brought to the United States in 1849, when nine choice animals were offered to our Government as a gift by the Sultan of Turkey. Many other flocks were imported later.

In Asia Minor, since about 1875, practically all of the Angoras have been crossed with common Kurd goats, a practice which elsewhere has been generally condemned. In this country, Angoras have been crossed to some extent with common goats to increase size and hardiness, but there are many purebred flocks.

The wavy, lustrous mohair fleece with which the Angora is covered should grow to a length of about 10 inches in a year. Unless an Angora is shorn each year the fleece is shed.

Until recently Angoras were grown principally for their mohair, but they are rapidly gaining favor as meat animals, and now the dual-purpose type is in demand. Every year thousands of kids and mature goats are slaughtered and marketed to be sold over butchers' counters as lamb and mutton.

Goats prefer young, slender, woody tips and twigs to grasses. Because of this they have been used very successfully in the

Northwest and in the South to clear land of brush, and have even been used for clearing fire breaks.

In the United States the largest numbers of Angoras are found on the range lands of Arizona, Texas, New Mexico, and in the northwestern states, but now every state possesses some flocks. For producing high-quality mohair, the Northwest, with its humid climate and large tracts of cut-over land, is unrivaled.

Success in Goat Raising. — Those planning to raise goats and to specialize in the production of mohair or other products of the animal should avail themselves of information from the goat growers themselves. Such information is far better than the most carefully systematized knowledge obtained by reading.

The use of goats for clearing brush areas, which is accomplished by heavy stocking and overgrazing, has created the impression that they can not be grazed without more or less serious damage to the pasture and young tree growth. Recent investigations have shown, however, that by proper management the range may be maintained in good condition, and that by judicious selection and management of the herd, goats may be expected to return a reasonable profit.¹

Success in goat raising is attained chiefly by adhering closely to the following program: First, select suitable range as pasture for the goats; second, adopt improved methods of management of the goat pasture, thereby insuring feed at all times; and third, increase the production of mohair and meat by careful selection of the goat herd.

PROPER CONDITIONS FOR RAISING GOATS

Climate. — In the United States goat raising is most successful on the mountainous lands which more nearly resemble the native habitat of the goat. Dry, rugged areas are better suited for goats than wet, marshy flats. Cold rains of long duration keep the animals unduly confined, as they must have shelter at such times. When suitable sheds are not available, serious losses

¹ Chapline, W. R., "Production of Goats on Far Western Ranges." U. S. Dept. of Agr. Bul. 749, 1919. The findings reported in this bulletin have been helpful in the preparation of this chapter.

may occur, especially after the animals have been sheared. Localities where the snowfall is heavy are not suited for winter grazing unless warm, dry sheds and ample supplemental feed are provided.

Forage. — It is unfortunate that the goat is credited almost everywhere with being a care-proof, "elm peeling" animal that will thrive with little or no attention. This popular conception is not true; the successful goat raiser must give just as careful attention to the details of his business as he would to the raising of any other kind of livestock.

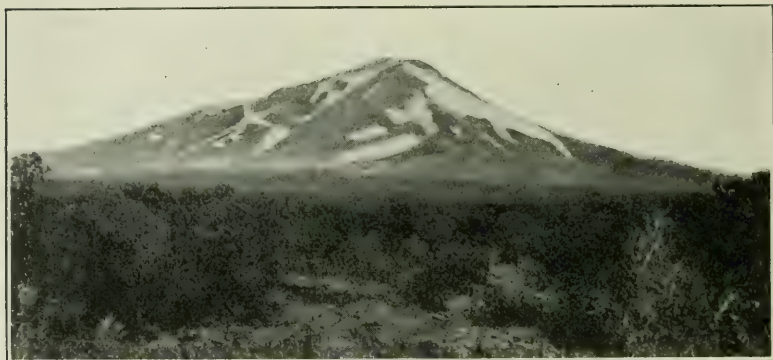
Goats are naturally browse animals, but a good goat range, in addition to furnishing abundant palatable brush, should have an admixture of grasses and broad-leaved herbs (non-grasses). This feed combination should be available during most of the year. Edible evergreen plants, such as mountain mahogany (*Cercocarpus*) and the evergreen oaks (*Quercus*), are very valuable for winter feed. Coniferous reproduction can not be classed as goat feed, and such vegetation, with the possible exception of juniper, is closely browsed only when the animals are badly handled or where the range is clearly overgrazed. Grasses and other succulent herbs are necessary for wet does, but they are of less importance on the winter range. Succulent feed is not essential for wethers or dry does.

During the summer, browse and a combination of grasses and broad-leaved herbs are cropped with about equal closeness. Evergreens, other than conifers, constitute important food plants in winter.

Nearly all species of browse are grazed to some extent by goats, but some are much better than others. Many of the species embraced in the following genera are of special value as food: Mountain mahogany (*Cercocarpus*), various species of oak (*Quercus*), snowberry (*Symphoricarpos*), buckbrush (*Ceanothus*), serviceberry (*Amelanchier*), rose (*Rosa*), winter fat (*Eurotia*), and sage (*Artemisia*).

Blue-brush (*Ceanothus integrissimus*) is probably the most valuable goat browse on the Pacific Coast (Fig. 52). Bitter-brush (*Purshia tridentata*), which is widely distributed on western

ranges, is also much relished and furnishes an abundance of valuable feed. Some species of manzanita (*Arctostaphylos*) are browsed in various localities. When goats browse manzanita closely, it indicates that the range is overgrazed, especially in California and Oregon. The grasses of high value for summer grazing are those that do not become coarse or tough early in the season. In the Northwest the bluegrasses, fescues, and certain



(W. R. Chapline)

FIG. 52. — GOAT BRUSH LAND NEAR MT. SHASTA, CALIFORNIA.

On parts of this range the brush is so heavy that even goats cannot penetrate into it. This range obviously is not suited to the grazing of horses, cattle, or sheep.

brome-grasses are most valuable, while on the southwestern ranges the gramas, particularly side-oat grama, blue grama, and hairy grama, as well as certain species of eragrostis, are among the best.

The broad-leaved herbs furnish good goat forage when green and tender, but as a rule they are not eaten during the winter after the leafage dries. An exception is found in alfilaria (*Erodium*). On the winter ranges of the Southwest, goats eat this herb with unusual relish. The chief value of the broad-leaved herbs on a good browse-type range is that they provide variety in the forage in spring and summer, and, being succulent, they increase the milk production of the wet does.

Water. — The availability of stock water often determines the stability and value of a range for goats. Abundant water

should be available on spring and summer range. On winter range, if snow is available, flowing water is of less importance. Pure, fresh water is desirable, but rain water stored in reservoirs is satisfactory. In the Southwest wells are often drilled to furnish a water supply throughout the year.

MAINTENANCE OF GOAT RANGE

Most goat ranges and pastures are grazed yearlong. The old practice of driving the goats from established corrals, located at the ranch headquarters, to the range and back again at night, has been largely responsible for the decline in the forage and injury to the young timber reproduction and to the watershed. Unfortunately, these injuries have caused a widespread belief that goats are always extremely destructive to the range. Investigations have shown that the damage is traceable to the method of management rather than to the habits of goats. Similar bad handling of cattle and sheep has brought about depletion of the cover in much the same degree and character.

The remedy lies in the adoption of methods of handling goats which will cause less trampling and at the same time bring bigger profits to the owner. The best plan is to divide the range or pasture into three areas, based upon the topography of the country, the type of forage, the availability of the water, and certain other factors. These should be used for (1) spring, (2) summer and fall, and (3) winter range. Such division of the range, according to season of use, will best meet the growth requirements of the forage as well as the foraging requirements of the animals.

Spring Range. — The spring range should have a good supply of grasses and broad-leaved herbs and a fair amount of palatable browse. The cover should be kept vigorous at all times in order not to impair the stand or cause the growth to be weak and late in starting in the spring. It is better by far not to graze the spring range overlong but to move the does and kids to the summer and fall range as soon as the forage is sufficiently developed.

Summer and Fall Range. — For several weeks after the band is moved to the summer range, the kids are dependent upon their mothers' milk and upon green, succulent food for their nourishment. Accordingly, the forage on the summer range should be well advanced in growth, but it should be green and tender rather than mature. Since any improvement in the forage crop on the summer range presupposes a stand of young forage seed-



(Forest Service.)

FIG. 53. — CUT-OVER FOREST LAND GRAZED BY GOATS IN THE AUTUMN.

Open, quiet grazing, as here shown, does not injure the forage or timber reproduction provided ample good feed is available.

lings, the animals should be herded quietly, and kept in open formation, as illustrated in Fig. 53, in order not to destroy the young plants. At this time, too, minimum use should be made of established bed grounds, and dogs had best not be used at all.

Winter Range. — During the winter the goats in many localities lose considerably in weight. Many individuals in the herd become so weak as the winter season progresses that they browse only in the vicinity of the corral or shed where the vegetation is grazed more closely than it will stand.

To control the loss of animals and to reduce the expense of supplemental feeding, the area chosen for winter range should be that which provides the greatest possible protection from storms. It is important that as much native forage as possible be protected at other times in the season so that the appetite of the animals may be satisfied without excessive travel. In winter, when the weather permits, it is advisable to bed the goats down about half a mile or so from the sheds. If this is done, and the direction of the bed ground from the sheds is altered regularly, the forage will be utilized evenly and the range will not be overgrazed in any one section. This practice also insures plenty of good feed for the entire herd, cuts losses to the minimum, promotes a healthy growth of mohair, and materially reduces the cost of supplemental feed.

GOATS FOR THE BEGINNER

High-grade Angora does, preferably range-raised, are the best investment for the beginner. Few beginners are properly equipped or experienced enough to produce purebred goats



(Forest Service.)

FIG. 54. — KIDS OF EXCELLENT QUALITY AND SIZE, SIX MONTHS OLD.

Only through careful selection and management is it possible to produce such desirable animals.

cheaply or to market them to advantage. The does should always be mated with registered bucks of desirable characteristics. It is best to purchase the bucks from breeders of known ability.

The desired type of the Angora goat is characterized by the following points: The ears should be drooping — so-called “fox ears” are objectionable; the color, white in kids as well as in mature does and bucks; the mohair should be fine, strong, dense, even, of long staple, white, closely curled, lustrous, and as free as possible from kemp (Fig. 54). The animals should be large, should possess a symmetrical, plump body, and should have a good constitution. The body and chest should be broad and deep, the shoulders nearly flat, the ribs well sprung, the back straight and wide, the thighs plump, and the legs sturdy, short, and wide apart. Animals of this type will produce a maximum amount of mohair and are superior for meat production.

MANAGEMENT OF GOATS ON THE RANGE

The proper management of goats on the range goes hand in hand with good management of the range itself, and very largely regulates the profit or loss from the band.

Size of Herd. — Goats are grazed in herds of from 300 to 1000 head or slightly more. The most profitable herds number about 1200 mature goats, not including their offspring. Small herds are seldom profitable, as the cost of handling a small herd is practically as great as for the larger band. On the other hand, herds containing many more than 1200 head are not profitable because the less aggressive individuals are forced to subsist on inferior forage and make poor returns. Moreover, the range is trampled badly and grazed destructively.

It is best to separate the breeding does from the dry does, wethers, yearlings, and weaned kids. This practice permits of much better handling of the does and their kids and gives the offspring a good start. The kids should be weaned at about five months of age. Not uncommonly, herded goats are kept in a compact band and trailed excessively. Instead of the herder and his dogs forcing the animals along from the rear and from one side to another, the herder should be in advance of the band to hold back the more aggressive leaders. Handled in this way, the herd will work slowly, quietly, and openly over the range and

the animals in the rear of the band will have a good chance at the better feed. Early in the morning the band should be allowed to drift slowly away from the bed ground. During the warm part of the day most of the animals will shade up under trees and brush.

Bedding-out vs. Established Bed Ground. — Improved methods of handling goats on the range have been developed gradually through the costly experience of making mistakes. Destructive overgrazing around bed grounds has been largely responsible for this change. Even now, however, many producers insist that goats have an inherent, persistent, and stubborn tendency to "go home" at night. This belief is erroneous. Herders who change camps often find that, by degrees at least, this "homing" tendency is overcome.

It is best to use several bed grounds at different places on the range as this insures even utilization of the forage over the area as a whole, improves the grazing capacity, and increases the weight of the animal and incidentally the mohair production. In the Southwest, kids in two herds, where handled under the one-night bed-ground system, gained 6.5 and 8.3 pounds more, respectively, than did kids of the same grade in a herd where one bed ground was used yearlong.

Goats should be bedded wherever night overtakes them. By the adoption of this method, open, quiet herding is assured; the goats are on good feed early in the morning, and they are allowed several hours of quiet grazing in the cool of the day, ample rest during the warmer part, and good grazing again later in the day. It is true that the bedding-out system can not be used entirely, as during kidding, or in stormy, cold weather, or immediately after shearing. But at all other times this practice should be followed.

Watering. — The frequency with which goats should be watered is determined by the nearness of the range to water, the character of the forage, and the season. Where heavy dews fall nightly and where the forage is succulent and the weather cool, goats can go without water for several days. When snow is available water is not needed for considerable periods. On dry

forage, especially during hot weather, and in the absence of dews, it is best to water the goats every day. The band should always be bedded away from water and grazed quietly to and from it. This practice protects the forage cover near the water.

Salting. — Goats, like other classes of livestock, are healthier and more content and make better gains if given plenty of salt at regular intervals. Feeding large amounts irregularly or at the end of long periods is not so satisfactory as regular salting. Coarse granulated salt is best. It should be given either in small quantities every night or in larger amounts once a week. It may be placed on rocks, in canvas or wooden troughs, or in boxes where it can be kept clean. Medicated salt is sometimes used. The owner should plan to have sufficient salt available so that each goat will consume about $3\frac{1}{2}$ pounds each year, or about $\frac{1}{3}$ pound per month.

Mating on Range. — Angoras are mated once a year, the breeding period being determined largely by the climatic conditions and the available green feed. The period of gestation is from 147 to 155 days. Generally goats are bred so that the kids will be dropped during March and April, as mild, settled weather may then be expected.

The bucks at breeding time should be over eighteen months of age. They should be kept in a thrifty condition throughout the year. One good thrifty buck will serve fifty does satisfactorily. The bucks should remain with the does forty days, as this will insure a maximum percentage of conceptions. Before breeding the mohair should be clipped from the buck's belly; otherwise it is likely to interfere with the mating.

The does should not be bred until they are eighteen months of age, and they should be in the best condition possible at breeding time.

Shearing and Care of Mohair. — The production of mohair in the United States is increasing rapidly. In 1910 the clip was 3,778,806 pounds; in 1920 it amounted to 6,808,813 pounds — an increase of 80.2 per cent. With the millions of acres in the United States suitable for goat raising and with constantly improving types of goats, this country in a few years should

produce all the mohair required by the domestic manufacturers who utilize this material.

Angoras will yield from 3 to 4 pounds of mohair for a twelve-months' growth. They are sheared once a year in the cooler climates and twice a year where the climate is mild. Shearing once a year insures a longer staple and a more valuable fleece than shearing twice yearly, but the amount of mohair from a single shearing is usually less than from the two clippings. In the cooler climates the herd is usually sheared in March or April; where the climate is mild, in February or March, and again in September or October. Both hand and machine shears are used but the latter are more popular. The fleeces should be rolled up inside out, left untied, and baled or sacked.

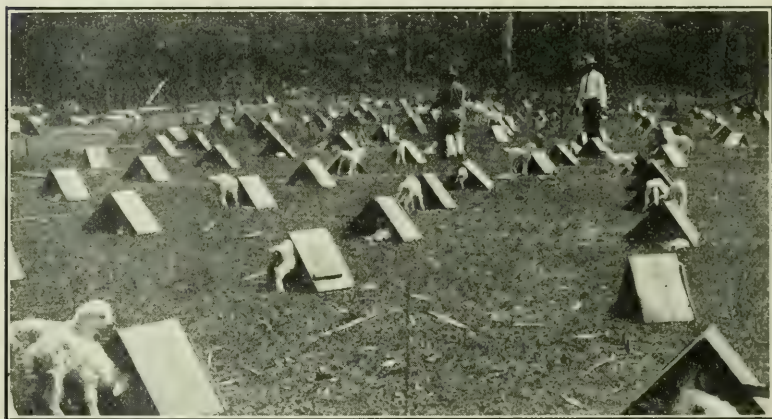
The market requires hair that is 6 inches in length. Kemp — a coarse fiber — is found commonly on the shoulder, neck, rump, and to some extent along the back. Its elimination by selective breeding is highly desirable. It is unfortunate that a large proportion of the mohair produced in this country is marketed by placing all grades in a single bag with little attention given to sorting. On most shearing floors no effort is made to keep the fleece intact. Thus when all grades are thrown together, grading later in the mills is impossible as the parted fleece is mixed with different grades of hair. So long as the clip is not graded the mohair does not meet the highest requirements of the manufacturer and accordingly must take a low price.

CARE AT KIDDING TIME

Careless methods invariably entail heavy losses of young kids, consequently an efficient system of kidding which will save a high percentage of the kids is one of the most important factors in profitable goat production. Many progressive and successful goat raisers of today have adopted one of two systems — the staking (toggle) system, or what is known as the pen (corral) system. Kids when first born are much more delicate than lambs and for several days can not endure much cold or damp weather. They can not follow their mothers to the range until they are several days old.

Handling Does during Kidding Time. — Most of the kids are born about the middle of the day and for that reason it is a good plan to take the ewes out to graze early in the morning and bring them in about 11 A.M. By 3 P.M. a large proportion of the kids for that day have been dropped and the band may again be taken out on the range and kept there until evening. Kids dropped on the range should be brought back to the camp, and the doe and her offspring should be similarly marked in order that they can be properly identified. Three or four men are required to attend the goats during the kidding period. One man looks after the drop band, another herds the wet band, the third looks after the kids, and a foreman is needed to help out generally and direct the work.

Care of Young Kids. — Under the toggle system the young kids are staked, while the pen or corral system permits the kids



(Forest Service.)

FIG. 55. — A TOGGLE KID CAMP AND INDIVIDUAL SHELTERS.

The kids are toggled for about 10 days, or until they are strong enough to follow the does to the range.

their freedom in small bands. In either case the does are taken out to graze each day and are returned to the kids at night.

Where the toggle system is used, room must be available for staking as many kids as may be dropped during a ten-day period (Fig. 55). Ten feet between stakes is the ideal space. The toggle system requires stakes with about 15 inches of rope

attached to a swivel on the stake end, and on the other end a small loop to be attached to the fetlock joint of the kid. Each kid is provided with a box for shelter from snow and storm. A suitable box which provides good protection can be made of 12-inch boards with one side open. Mostly inverted V-shaped boxes or shingle coverings are used.

The ideal toggle camp should have a good slope for drainage. Experienced does will spend the night at the upper side, and therefore their kids should be staked there. On cold, rainy nights the does should be confined or otherwise kept out of the staking camp, for whenever a doe passes through the yard to her kid, other kids will come out of the boxes and may suffer from exposure.

A doe that disowns her kid should be staked with it. If a doe dies another doe will claim the orphan or a twin kid if immediately staked with it. She must, however, be either confined with the kid in a closed pen or staked with it until she accepts it as her own. The appearance of "dogies," the name given to orphan kids, indicates that no serious attempt has been made to provide foster mothers for them.

Each morning and evening the herder should pass through the toggle camp to see that every kid is nursed. If a kid is restless or is not doing well its mother should be brought to the stake; likewise, a doe with distended udders should be brought to the kid that carries her number or mark. Generally, kids should not be kept in the stake camp more than ten days. At that age they should be herded with their mothers in a small field or on level range where the forage is abundant and of good quality. When they are about six weeks old kids may be turned on any type of range with the does.

The pen or corral system of kidding is gaining in popularity. Less work is required in handling the animals, and the results are as good as those obtained by using the toggle system. Indeed, even where the toggle system is used it is worth while to have individual kidding pens.

The kids and does are placed in so-called "handling" pens, each of which should be large enough to hold about fifty does and

their kids. For a herd of 1200 does about eight pens should be provided. The does are taken out to graze while the kids remain in the pens. Kids of the same age should be confined in the same handling pen. Care should be exercised at all times to see that the doe and her kid are together. Each doe should be marked to show the pen in which her kid is left, and the doe and kid should be so marked as to identify them as belonging to each other.

When the kids are several days old they should be removed from the handling pen and placed, with their mothers, in a mixing pen large enough to permit grazing. Here the less attentive doe and her kid learn to recognize each other. From the mixing pen the does and kids are shifted into a larger pen, and from there to the range.

Branding and Castrating. — On the range branding is necessary for the identification of strayed animals and to prevent theft. It is best to use a branding fluid as it will not injure the mohair as do paint brands. If branding is employed, the brand can be placed on the face, or the animal may be marked for identification by ear crops, splits, or tattoos in the ear.

The male kids should be castrated when from one to three weeks old. The operation is the same as with lambs, the end of the scrotum being cut off and the testicles drawn out with a steady pull. It is not uncommon among kids to find that only one testicle has descended into the scrotum. This testicle should be removed and the animal marked for early slaughter or for re-examination and castration later.

Goat Meat. — During a five-year period (1916-1920, inclusive) an average of 141,847 goats were slaughtered annually in the United States under Government inspection. Thousands of goats were also slaughtered by country butchers; of these there are no records. Care in breeding and feeding makes goat meat as delicious and wholesome as that of sheep. Curiously, however, where two dressed carcasses are hung in a butcher shop, one of which is labeled "mutton" and the other "goat meat," the latter will be unsold. If these same carcasses are hung unlabeled and the price is the same, the carcass that is the easier

for the butcher to reach will be the first one sold. Moreover, the customer who purchases the unlabeled goat meat will come back for more. Goat meat, more than that of any other animal, needs effective publicity. Goat meat generally goes into the regular mutton trade as mutton as there is no Federal restriction affecting the marketing of it in this way. It is because of the sweetness of well-finished goat meat that consumers of this meat claim to be able to distinguish between it and mutton. Goat carcasses that are not well finished do not dress out as high a percentage as a sheep carcass of similar quality, and the packer discriminates against them sharply. Poorly finished animals must be sold as canners.

PROFITS IN GOATS

The cost of running goats and the profit from them naturally varies in different localities and according to the method of handling. Feed, losses, labor, buck service, depreciation, interest on the investment, and the cost of the necessary equipment are the main items of expense.

The cost per year of running goats is about the same as for sheep. Where a good kid crop is procured, the profit from goats is little less than that from sheep.

DISEASES OF GOATS

Those who have observed shirts, socks, the usual collection of back alley débris, poisonous plants, and similar "rare delicacies" disappear into the digestive tract of the goat, will marvel to learn that there exists any disease sufficiently virulent to kill him. While it is true that the things goats will devour surpass all understanding, they are susceptible to a few ailments.

Two diseases, takosis and Malta fever, are responsible for the majority of the losses in goats.

Takosis. — One of the most contagious diseases to which Angora goats are susceptible is takosis. For several years this disease was so prevalent in some of the northern states that it threatened to wipe out the Angora goat industry in those dis-

tricts. Before a remedy was found the losses acted as a check to the expansion of the goat industry, and even yet the industry has not fully recovered from the setback.

The death rate in a flock where takosis is prevalent is exceedingly high, ranging from 30 to 85 per cent. Besides the loss from deaths there is a tendency among the pregnant surviving does toward abortion. In some large herds where takosis has been present during the year, the increase is sometimes not more than ten kids to each thousand does.

Takosis is a progressive, debilitating, contagious disease which is characterized by great emaciation and weakness. The symptoms are diarrhea and pneumonia.

There are few indications of takosis in its early stages. A languid and listless appearance is usually the first and most striking symptom of the affected goat. The pulse is slow and feeble, and in the beginning there is a slight rise in temperature but before death the temperature becomes subnormal. Snuffling and coughing are sometimes in evidence.

The movements of the animal become slower and slower as the disease progresses. The back is arched and the head drawn down. Meanwhile the victim's weight constantly shrinks. Finally the animal becomes so weak that he is easily knocked over and trampled upon by his fellows. If picked up he is able to move on, but is soon down again. He may linger on in this way for several days. During the last few days there is a fluid discharge from the bowels with a very offensive odor. The course of the disease is run in from eight days to six or eight weeks. The younger goats are the more susceptible to takosis.

The following summary of measures for the prevention of the disease are advocated as a result of painstaking researches.²

Avoid sudden climatic changes in moving animals from one locality to another. Summer is the best time for transportation. The diseased or weakened goats should be separated from the others and given special care and shelter.

The stables and sheds in which the goats are kept should not

² Mohler, J. R., and Washburn, H. J., "Takosis, a Contagious Disease of Goats." U. S. Dept. of Agr., Bur. Animal Ind., Bul. 45, pp. 41-44, 1903.

only be thoroughly dry but should be on land that has natural drainage. This protection should be accessible to the diseased band at all times. Goats suffer in wet weather because their fleece, unlike that of sheep, contains no yolk to enable them to shed water; consequently a fall of rain penetrates to the skin.

If takosis makes its appearance in the herd, all animals showing symptoms should be isolated. Medical treatment has been attempted with varying success. Immunizing, however, has given by far the best results. When accompanied by isolation and disinfection, the treatment may prove of great assistance in the suppression and eradication of the disease in an infected flock.

Malta Fever. — What has been called “rock fever” and goat fever on the Island of Malta, is correctly known as Malta fever. In 1905 a commission was appointed by the British Government to investigate the cause of the numerous deaths of human beings on the island. The commission found that the main factor in the dissemination of the disease was the milk from the native goats.

Malta fever is an affliction of man, and to a lesser extent of goats, which is characterized by protracted remittent fever. Usually there is also swelling of the joints, rheumatic pains, and anemia associated with the fever. The mortality among humans is about 3 per cent.

The symptoms of the disease in goats are almost imperceptible. The appetite is normal, the health seemingly good, and a continual gain in weight is made even while the disease is in progress.

The most important symptom of Malta fever is the frequency of abortions which result in the course of the disease. From 50 to 90 per cent of the pregnant animals which are affected with the fever abort, and the abortions may also recur in the succeeding or even the third gestation following the infection. The fetus may be carried the full time, but it is usually either born dead or dies within a short time after birth.

Malta fever is found in many of the southern European countries, in South America, Africa, and Asia, and on islands in various parts of the world. It has been known in Texas and New

Mexico, under such names as mountain fever and slow typhoid fever, for twenty-five years. All the cases of Malta fever in these states have been among people who were connected with goat raising. The disease is most prevalent in April, May, and June, during the kidding season.

The principal source of infection in man is through the milk of the infected goats. The dissemination of Malta fever among animals, however, is by direct contact as well as by infection through the urine, excreta, and contaminated dust. The organism that causes the disease usually enters the system through the alimentary canal.

The eradication of Malta fever from a large herd of goats is difficult. Vaccine treatment has proved of doubtful value and medical measures have been unsuccessful. Where the disease occurs, all the goats' milk should be pasteurized. The corrals and kidding pens should be moved some distance from the house, and the infected corrals, pens, and utensils must be thoroughly disinfected. Coal-tar sheep dips, cresol, carbolic acid, or chlorid of lime can be used for this purpose.

QUESTIONS

1. (a) What is the native home of the Angora? (b) In what parts of the United States is the raising of Angora goats popular? Why?
2. (a) What factors should be considered in successful goat raising? (b) Discuss the handling of goats with respect to climate; forage; water.
3. (a) Why are most goat ranges overgrazed? (b) Discuss fully the remedy for depleted goat pastures.
4. What constitutes a good spring range for goats? A good summer and fall range? A good winter range?
5. (a) What constitutes the proper number of goats in a range herd? Why? (b) Discuss the practice of bedding out goats as compared with the use of an established bed ground.
6. (a) How often should goats be watered in summer? In winter? (b) How often should goats be salted? What kind of salt should be used?
7. (a) What is the gestation period of goats? (b) At what season should the kids be dropped? (c) How old should the bucks be at breeding time? (d) How many bucks should be used with a band of 1200 does? How long should the bucks remain in the herd during the breeding season?
8. (a) When and how often are goats sheared? (b) Is the shearing done

by hand or with machines? (c) Discuss the market requirements of mohair.

9. (a) What systems are used in kidding and what are the merits of each? (b) How are the does handled during kidding time? (c) How and where are goats branded or marked? (d) When should the kids be castrated?

10. (a) Discuss the status of goat meat for human consumption. (b) What is the approximate cost per annum of running a goat? (c) To what extent have takosis and Malta fever curtailed the expansion of the Angora goat industry? (d) Discuss the nature and symptoms of takosis and Malta fever in goats.

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PART THREE

PASTURE HUSBANDRY OF BEEF CATTLE

CHAPTER XIII

LEADING BREEDS OF BEEF CATTLE: THEIR ADAPTABILITY TO RANGE AND FARM

One of the questions commonly asked concerning cattle pertains to the breed which should be used in certain localities and under certain conditions. Careful consideration of this question is fully justified, for there is a greater difference in the characteristics and adaptability of beef cattle than is generally supposed. Some breeds have qualities superior to other breeds, and one breed may be far better suited to the conditions existing in one state or locality than any other breed. It is the object of this discussion to point out the distinguishing characteristics of the leading beef breeds of the United States and their adaptability to different forage regions and grazing practices.

The leading breeds of beef cattle in the United States are the Hereford, Shorthorn (including the Polled Durham), Aberdeen-Angus, and Galloway. In addition to these the Brahman or "Indian" cattle are popular in certain regions of the south. A tabular comparison of our common beef breeds is given at the end of this chapter.

THE HEREFORD

One of the oldest English breeds of domestic cattle, if not the oldest, is the Hereford. As far back as 1637, the cattle of the County of Hereford, which lies in the southwestern part of England, were mentioned in historical records as being remarkably easy to keep and to fatten. It is assumed that these cattle are descendants of the aboriginal herds of that country, and that originally they were entirely red in color. The white cattle of Wales were crossed with the native stock and gave to this breed white markings and a larger frame. White-faced English bulls and Flemish cattle, which were crossed with them later, stamped

the white markings still more securely. Later the name of Hereford was used to designate the improved and pedigreed race of cattle developed from the Hereford County native stock. They were then cattle with well-established breed characteristics that were reliably transmitted.

As the early Hereford breeders had different breeding ideals, much diversity of color and physical features was to be found among the Hereford cattle of that date. When the first Hereford book was prepared in 1845, there were still several different strains of Hereford cattle, distinguished mainly by their color markings. Later the improvers inbred these different strains, and within a few years the present-day uniform Hereford color and markings were established.

Up to 1840 few Herefords had been imported to America. One reason was the difficulty and risk of transportation; another was that the Hereford's milking qualities were not equal to those of other breeds. Their excellent beef qualities had not become generally known. In 1840, however, a fairly large importation was made. Descendants of these cattle have continued since then in unbroken line in the herds of this country. In 1876, at the Centennial Exposition in Philadelphia, an attractive herd of Herefords was exhibited and received much attention, especially from western cattlemen. By this time the cattle-growing industry west of the Missouri had assumed enormous proportions. Western cattle growers were impressed with the uniform color and marking of the exhibition herd as well as with their beef-carrying qualities, and they bought and shipped bulls of this breed to their herds. The Hereford bull, when bred to range cows, transmitted his breed characteristics to his offspring, and the breed proved eminently fitted for range conditions. During the next decade the cattle owners of the range country from Texas to Wyoming bought all the Hereford bulls obtainable.

In addition to the ability of the Herefords to breed up the native stock, it was also found that they produced beef rapidly on grass. The "white faces" are hardy enough to do well in the northern latitudes, and they also have a good reputation in the southern states. When the conditions on the range changed

and western steers were sent to the feed lots of the corn states, it was found that the Herefords responded quickly to the fattening ration and produced, when finished, a high quality of meat. Later, when there was a demand for "baby beef," the steer calves were taken from their mothers at weaning time and shipped to the feed lots. The grade Hereford, in the production of "baby beef," is not excelled by the grade of any other breed.

The Hereford Type. — The color markings of the Hereford are, to the casual observer, his most distinctive feature. The



FIG. 56. — LADY ELLEN AND HER CHAMPION SONS, ARDMORE AND EMANCIPATOR THE FOURTH.

head, crest, and throat are white, as are also the breast, belly, and bush of the tail, and there is usually considerable white on the legs. The sides of the neck, the body, and usually some parts of the legs are red. These are the usual markings although there are many variations. The red may shade from nearly yellow to a red so dark as to approach black. Many breeders prefer the deep, rich red, but the shade of color has no particular signifi-

cance. The hair is sometimes straight and sometimes curly; preference is sometimes given to the curly coat.

In form the Hereford is low, compact, and blocky, with well-sprung ribs, a broad loin, and wide hips. When the animal is in good condition all the bones of the frame are so well covered with flesh that it is difficult to feel them. The mature Hereford bull weighs from 1800 to 2200 pounds, and the cows range from 1200 to 1600 pounds. The head is short with a broad forehead, full eyes, and a large muzzle and mouth. The horns are fairly prominent, with a drooping tendency. The neck is short and thick and merges smoothly into the shoulders. The legs are short and stocky (Fig. 56).

Herefords on Range and Farm. — The unrivaled rustling qualities and hardiness under range conditions, and the ability to accumulate flesh at all ages, have popularized the Hereford among cattle owners of the West where the breed now outnumbered any other. No breed is superior to the Hereford for withstanding the vicissitudes of the open range, with its "lean" years of limited forage and bleak, long winters. Moreover, the Hereford does well on all kinds of cattle feeds and responds to a ration of grain as quickly as any other beef breed. No claim for milk production has ever been made for the Hereford cow, for it is preëminently a beef breed. Herefords are less docile than Shorthorns, and do not adjust themselves so readily to the average farm conditions of confined quarters.

THE POLLED HEREFORD

The polled or hornless breeds imported from Scotland found such favor in the feed lot (on account of their hornless character) that a few Hereford breeders have undertaken to develop a polled strain of Herefords. This has not been an easy undertaking as there are few so-called hornless sports among the purebred Herefords.

Because of the scarcity of polled Herefords, close breeding has been necessary, and since not all the hornless sports have been good individuals, the close breeding has fixed in their offspring

some undesirable features. In time careful breeding and feeding may overcome these difficulties and a polled strain may be developed which will have many good qualities besides that of being hornless.

THE SHORTHORNS

Shorthorns, so called because of the comparative shortness of their horns, are the most popular of the beef breeds in point of numbers and in general distribution. They were formerly called Durhams, after the county where the breed was developed. Durham County lies in the Valley of the Tees, in northeastern England. Authorities differ as to what particular stock was used in developing this breed, but all agree that the native cattle of that section were the most important factor entering into the production of Shorthorns. The Romans, Saxons, Danes, and Normans, who in turn conquered England, brought with them cattle, which were crossed on the native stock, but after the Norman conquest there was no importation of stock for several centuries. This halt in importations allowed a distinctive breed of cattle to be developed.

In the early days there were two distinct strains, but in the latter part of the eighteenth century these were blended. The Shorthorns of that time possessed broad, high frames and good milking qualities. They fattened easily but the flesh was coarse-grained. Although the carcass was larger than that of the present-day Shorthorn, the latter is more symmetrical, produces a larger amount of high-quality meat, and matures earlier. By the middle of the eighteenth century a decided improvement in breeding began, and there were several good Shorthorn herds, judged by present-day standards, in northern England.

Early in the nineteenth century, a number of English breeders, by methodical, careful selection and inbreeding, succeeded in setting standards toward which contemporary breeders aimed. The Colling Brothers and Amos Cruickshank were among the noted breeders of that period. The first recorded importations of Shorthorns to America were in 1783 and in 1795. From that

time on, the number of animals brought to this country grew steadily, until in 1846 there were sufficient to warrant the publishing of an American Shorthorn herd book. Today the Shorthorn is found in every state in the union and is the most numerous of any breed.

There are three important strains found among the Shorthorns — the Booth, the Bates, and the Scotch. The Scotch and the Booth are true beef-type animals, while the Bates strain approaches the dual-purpose type.

The Shorthorn Type. — The Shorthorn breed is characterized by a deep, wide, thickly fleshed form of true beef conformation.



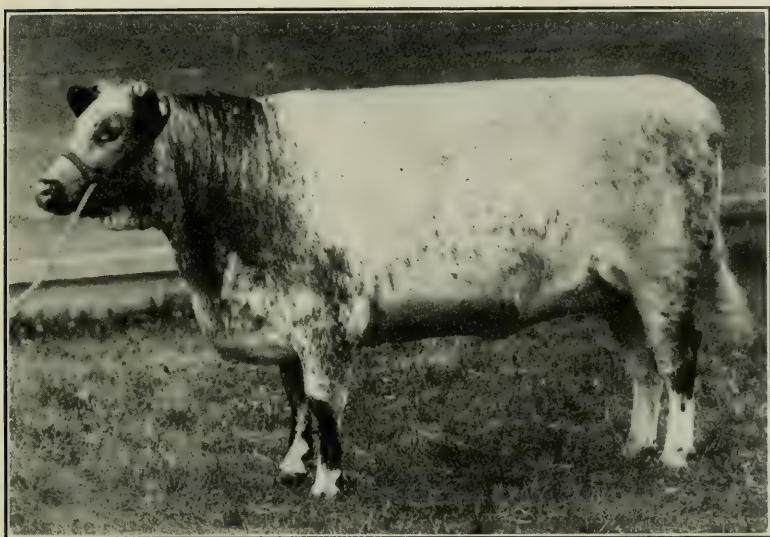
(U. S. D. A.)

FIG. 57. — CHAMPION SHORTHORN BULL.

Because of its great width and depth, the Shorthorn possesses a more rectangular appearance than any other beef breed. In proportion to the rest of the animal, the head of a Shorthorn is small, with small curved horns on the cow. The head of the bull is larger, with straighter horns.

The neck of the male is medium in length, strong, and arched. As the neck approaches the shoulders it widens and deepens and is rounded. In the female the neck is finer in outline than in the male. The hind quarters are better developed in the Short-

horn than in any other breed, and the short, well-placed legs are clean-cut with fine lines below the hock. The skin is medium thick and well covered with fine hair. The color of the Shorthorn is more variable than that of any other breed of cattle. It may be pure white, pure red, roan, or a mixture of red and white (Figs. 57 and 58).



(U. S. D. A.)

FIG. 58. — PRIZE SHORTHORN COW OF SUPERB TYPE.

Shorthorns on Range and Farm. — During the rapid development of the cattle industry in the western states, a large number of eastern-bred Shorthorns formed the foundation herds. In 1847, for instance, the Mormons who settled in Utah took with them a large number of a fairly good type of Shorthorns, and for many years there was practically no other breed of cattle in that great range state. Furnishing, as they did, an abundance of milk and beef on the virgin grass meadows of the valleys, the Shorthorns were admirably suited to the existent conditions. It was not long, however, before the herds were forced back into the rugged, bleak mountain lands and the sparsely vegetated desert ranges. Here the vitality and breeding qualities of the

Shorthorns declined. They lacked the rustling qualities so admirably developed in the Hereford and consequently the Hereford has largely replaced the Shorthorn on many western ranges. The Shorthorns have, however, proved valuable in grading up the herds on western ranges, as they cross well with other breeds or with scrubs and tend to increase the milking capacity of range cows. In American cattle markets the number of grade Shorthorns exceeds that of any other cross.

Where feed is plentiful, Shorthorns will produce meat as cheaply and about as quickly as any breed. Their abundant milk supply always insures the raising of a good calf, and in ability to adapt themselves to varying conditions of climate and treatment they stand high. Although the temperate regions are their natural habitat they will adjust themselves to either hotter or colder climates. A system of mixed farming, such as is found in the Middle West, provides a good environment. The gentle disposition of the Shorthorn cow, combined with her milking qualities and her high beef standard, has made her a favorite on the general farm.

THE ABERDEEN-ANGUS

The Aberdeen-Angus cattle have been bred primarily for beef production. The individuals are solid black in color and are hornless or "muley." They are named for two shires in the northeastern part of Scotland.

This breed has existed so long in Scotland that its origin is lost in the mists of antiquity. It is well known that there were polled animals among the wild white cattle of Britain, and the Aberdeen-Angus may have sprung from these. Some who have speculated on the origin of the breed contend, however, that it sprang from a black-horned breed which for a long time was popular in Scotland. Aberdeen-Angus cattle have always been great favorites in Scotland, but as disease nearly wiped out the breed once or twice, there were few available for export until the latter part of the nineteenth century.

Hugh Watson of Angusshire made the earliest attempt to improve the breed. This was in 1805. A few years later, some

breeders in Aberdeenshire began the same work. Considerable rivalry arose as to the merits of the two strains. Later breeders inbred the two strains and, to please both shires, adopted the name Polled-Aberdeen or Polled-Angus cattle. "Polled" was later dropped from the name, and the breed is now called Aberdeen-Angus.

The first public appearance of this breed outside of the British Isles was in 1878 at the World's Fair in Paris. A herd of fifteen Aberdeen-Angus won the champion herd prize there against nearly 2000 other cattle of various breeds.

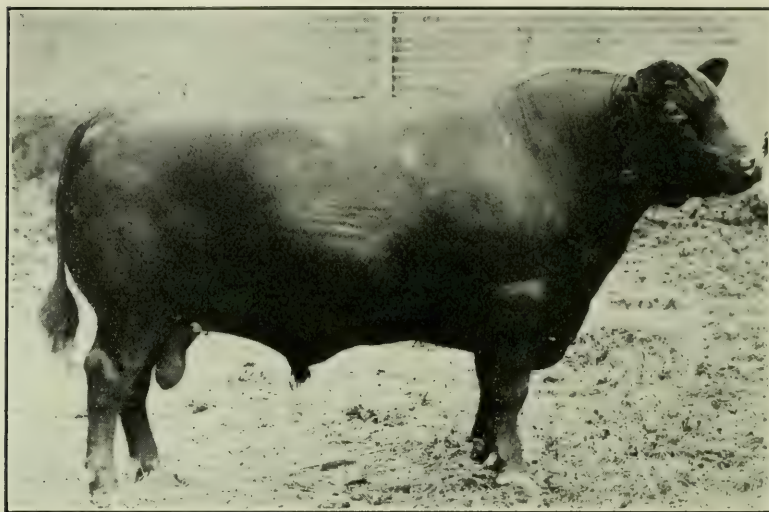
This success led some Americans to import a few head in 1878. Since then the Aberdeen-Angus have grown in public favor until they are now recognized in this country and elsewhere as one of the most desirable beef breeds.

The Angus of today are hardy and are best adapted to a temperate climate, although herds are found in every state in the Union. They are also popular in Canada, in various parts of England, France, Ireland, Germany, the Scandinavian countries, Russia, South America, New Zealand, and elsewhere. Until recently Aberdeen-Angus were rather slow in maturing, but now with good feeding they can be finished at as early an age as any breed. The flesh is of the highest quality and is well mixed with fat.

The Aberdeen-Angus Type. — The characteristics of the Aberdeen-Angus are strongly developed. When a purebred bull of this breed is crossed on horned cows of various colors, a large proportion of the offspring will be black and mostly polled. The individuals of this breed are not quite so large as the Shorthorns and Herefords but they weigh well in proportion to their size.

The Angus body is smooth, symmetrical, and rotundly compact. It is not rectangular, like that of a Shorthorn or Hereford, but is more cylindrical in form. The hind quarters are deep and full and dress out a large percentage of high-quality beef. The chest is deep, wide, and long, and the head has a sharp-tapered poll. There is much breadth between the eyes. The neck is short and full and does not blend so smoothly on to the shoulders as it does in some of the other beef breeds. The quality of the

breed is very good, as shown by the mellow, medium-thick skin, the rather fine hair, the neat joints, and the fine bone. Compared with the Galloway, the Angus has shorter and smoother hair, a thinner skin, and a somewhat blockier body (Figs. 59 and 60).



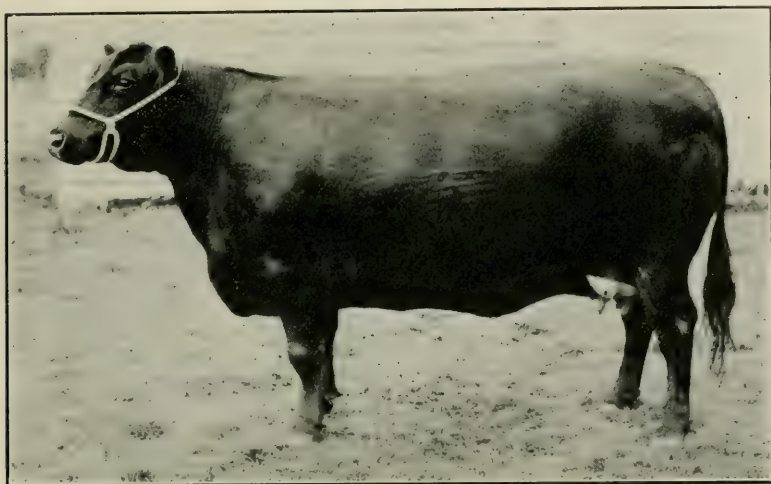
(U. S. D. A.)

FIG. 59. — CHAMPION ABERDEEN-ANGUS BULL.

One objection to the breed is that the animals are of a nervous temperament and are not so easy to handle — for example as the Shorthorns. They are a large breed, the bulls easily attaining a weight of about 2200 pounds, and the cows about 1400.

Aberdeen-Angus on Range and Farm. — On the range the Angus ranks high in beef production. The breed possesses unusual rustling qualities, withstands inclement weather well, and thrives on a variety of range forage. The cows are better milk producers than those of the Hereford breed, though not equal in this respect to the Shorthorn. They nourish their calves well. One rather serious objection to the Aberdeen-Angus on the range, however, is that they often become very wild and difficult to handle. An experienced cowboy once remarked to the writer that “roundin’ up and hog-tyin’ a bunch

of elk is a peck of fun, and one is usually on the look-out for trouble which never materializes; but roundin' up a bunch of them black muley devils is all work and not a —— bit of fun and unexpected trouble pops up in the handlin' of every blasted one of 'em."



(U. S. D. A.)

FIG. 60. — PRIZE ABERDEEN-ANGUS COW.

It must be admitted that in rough, rugged country the Angus is considerably more difficult to handle than his more popular Hereford rival. Then, too, regardless of the good results obtained, some ranchmen object to using the Angus bulls for breeding up their herds because in the first generation a large proportion of the offspring are likely to be black and white in color, resembling somewhat the markings of the grade Holstein. Feeders discriminate sharply against animals that appear to carry a strain of dairy blood. Naturally, therefore, the Angus crossbred feeder, regardless of symmetry of form and early-maturing qualities, often brings an appreciably lower price than crossbred animals of the Hereford and Shorthorn blood.

Under semi-range conditions or on the farm, especially where an early-maturing product is desired, the Aberdeen-Angus gives an excellent account of himself. For the past twenty years the

breed has repeatedly topped the fat-beef market. At the International Fat Stock Show, both individuals and carload lots have repeatedly taken blue ribbons.

THE GALLOWAY

The Galloway derives its name from the Province of Galloway, which lies in the southwestern part of Scotland. Cattle raising has been the principal business of the Galloway farmers since time immemorial. One of the evidences of this breed's antiquity is found in the hornlessness of the purebred Galloway and in his power to remove horns when crossed on other breeds. The true origin of the breed, like that of the Aberdeen-Angus, is largely speculative. The treatment given this breed for centuries and the cold, damp climate of its native land have developed animals with long, wavy hair. They are good rustlers and are able to withstand severe weather.

In 1853 the breed was formally introduced into Canada and as they were found to be very adaptable to Canadian conditions their number rapidly increased. Today they are among the most popular of the beef breeds. A few head were brought into Michigan in 1870 and from there they have spread all over the United States. Galloways have never been so popular in the corn states as in the range country of the North and Northwest because they do not respond so well to good treatment as do other breeds.

The Galloway Type. — The modern Galloway possesses a low, blocky form, covered with a long, soft, wavy coat of black hair. The body, slightly longer than that of the Aberdeen-Angus, resembles a barrel in shape and is well and evenly covered with flesh. The head is short, wide, and hornless, and in shape resembles somewhat that of an Aberdeen-Angus. The hind quarters are full, the bone fine, the skin mellow, the hair silky, and the meat of fine quality and richly flavored. In size the Galloway is the smallest of the popular beef breeds. Mature bulls usually weigh from 1700 to 1900 pounds (Fig. 61), and mature cows weigh from 1100 to 1350 pounds.

The breed has been improved chiefly along the lines of beef production, but the cows give milk enough to raise a good calf, and the milk is always rich. The Galloway is very prepotent, possesses the ability to perpetuate his characteristics as uniformly as any breed, and has done much to improve range herds. From November to March his coat is so superior to that of any other cattle hide that it usually brings from 5 to 8 cents more per pound. The Galloway has taken the place of the buffalo in producing robe materials.

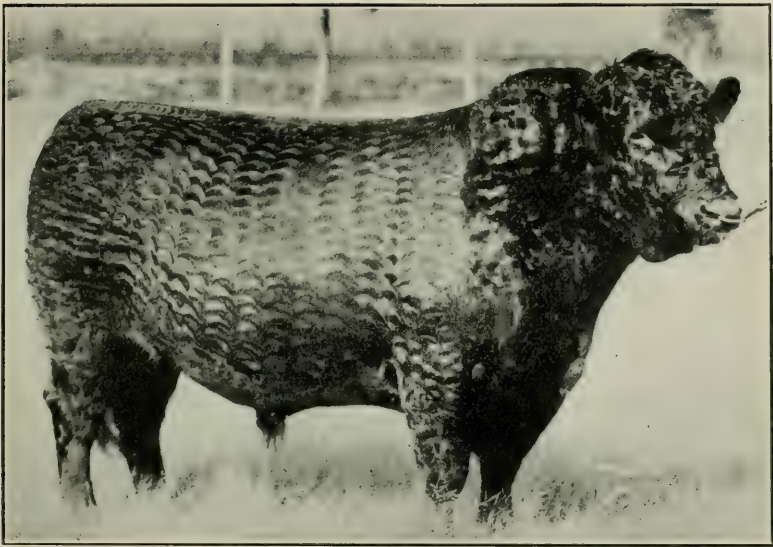


FIG. 61. — CHAMPION GALLOWAY BULL.

Galloways on Range and Farm. — The hardiness and rustling qualities of the Galloway make it eminently suited to the ranges of the North and Northwest where the rigors of winter are great.

This breed will probably never be very popular on farms in the United States. The Galloway's small size, its adaptability to the cooler climates, and its somewhat slower response to generous feeding than that of other beef breeds are its chief limitations as a farm animal.

DUAL-PURPOSE BREEDS

The Red Polled, the Devon, and certain strains of the Short-horn are the principal dual-purpose breeds in the United States. The dual-purpose cow is bred to produce an abundance of milk and butterfat and a calf of desirable beef type. As the true dairy and beef types differ markedly, the dual-purpose animal does not excel either in the production of beef or dairy products, but is good in both. Whether the character of one of these types predominates is determined largely by the ideals of the breeder. For this reason dual-purpose cattle are seldom as uniform in conformation as are animals of a strictly dairy or of a beef breed.

Dual-purpose cattle are not popular with the ranchman or the farmer whose chief aim is to produce animals for the block. The small farmer who wants both dairy products and beef finds dual-purpose cattle well suited to his needs.

BRAHMAN OR "INDIAN" CATTLE

This breed, also called Zebu cattle (*Bos indicus*), is of a different species from our common cattle. There are several strains of Brahmans, many of which differ so greatly in type, size, and color as to be recognized as separate breeds. The most valuable breeds are those known as Krishna and Hissar. Both are of the dual-purpose type, as the cows give a good flow of rich milk. In India they are relied upon as milk cows and are exceedingly well adapted to the warm, trying climates.

The Brahman cattle cross readily with our breeds of beef cattle. Brahmans are more nervous than any of our common beef breeds, yet a trace of this blood — say, one-sixteenth — mingled with that of one of our beef breeds, is not without merit on the tick-infested ranges of the South. One peculiarity of the Brahman cattle is the liberal secretion from the sebaceous glands of an oil having a peculiar odor. This oily covering of the skin, combined with sparse hairiness and a tough hide, affords the breed a remarkable amount of protection from ticks, mosquitoes, screw-worm, and similar pests. Purebred Brahman cattle are

tick-exempt; half-breeds are practically free from ticks; and one-fourth, one-eighth, and even one-sixteenth breeds suffer much less from ticks than the most immune of our native beef breeds.

Brahmans are of medium size, the bulls weighing from 1500 to 1800 pounds, many of them attaining a height of 6 feet, whereas the cows usually weigh from 1100 to 1400 pounds. The quality of the beef of purebred Brahmans is rather coarse and slightly inferior to that of our beef breeds. However, they dress out a high percentage of meat.

The Brahman Type.—The most characteristic features of the breed are the large hump on the withers (which in the males

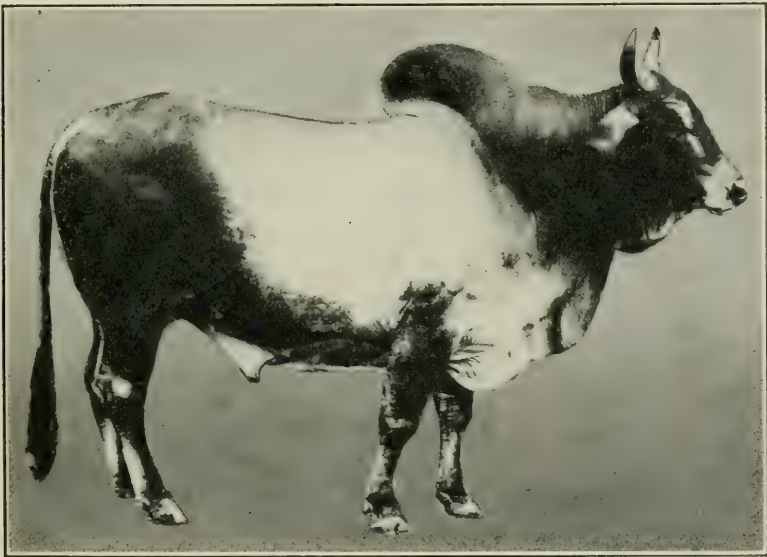


FIG. 62.—BRAHMAN BULL, CHARACTERIZED BY THE LARGE HUMP ON THE WETHERS.

attains a height of from 12 to 16 inches); the long, drooping, pendulous ears; the large fold of skin forming the dewlap and the navel; and the long, tapering head. The eyes are mild and sleepy until the animal is aroused. The neck is of medium length; the body is deep but rather narrow; and the legs are long, with a strong bone free from coarseness (Fig. 62).

Brahmans on Range and Farm. — Owing to the nervous disposition of purebred Brahman cattle and the fact that they are not a superior beef type, it is not practicable to raise them on the range. When handled much they become docile, but under range conditions they are wild and fight or stampede readily. The usefulness of the breed in this country is confined to the introduction of a small amount of the blood in those of our beef cattle that are handled on ranges of the South where ticks and certain other blood-sucking pests are an important factor in the economic production of beef.

CHARACTERISTICS OF THE COMMON BREEDS OF BEEF CATTLE

The following table has been prepared to show the more typical characteristics of the common breeds of beef cattle.

SUMMARY OF CHARACTERISTICS OF THE COMMON BREEDS OF BEEF CATTLE

Characteristics	Hereford	Shorthorn	Aberdeen-Angus	Galloway
Size in pounds..... (Using bull as index)	1800-2000	1800-2000	1800-1900	1700-1900
Maturity.....	Early	Medium early	Early	Medium early
Temperament.....	Medium docile	Docile and phlegmatic	Somewhat nervous	Medium docile
Milking qualities....	Poor	Excellent	Good	Fair to good
Prolificacy.....	Excellent	Excellent	Excellent	Excellent
Prepotency.....	Markedly prepotent	Strongly prepotent	Strongly prepotent	Strongly prepotent
Crossing: Extent of practice.....	Extensively used	Extensively used	Commonly used	Restricted
Qualities imparted by crossing.....	Rustling qualities on range; early maturity; uniform markings; heavy front quarters	Increased size; more milk; improved handling qualities; heavy hind quarters	Early maturity and blockiness; increased dressing percentage; hornless offspring	Hardiness; improved quality of meat; greater milking capacity

QUESTIONS

1. (a) What are the leading breeds of beef cattle in the United States? (b) From what stock are the Herefords thought to have originated? (c) When were Hereford cattle introduced into this country? (d) Describe the Hereford type. (e) Discuss the suitability of the Hereford for the range; for the farm.
2. (a) How does the polled Hereford differ essentially from the common or horned Hereford? (b) Why is the polled Hereford not as popular as the Hereford?
3. (a) How do Shorthorn cattle differ from the Durham? (b) Name two men who greatly improved the type of the Shorthorn cattle early in the nineteenth century. (c) When were the first Shorthorns imported into the United States? (d) Describe the Shorthorn type and point out how it differs from the Hereford. (e) Discuss the suitability of the Shorthorn for (1) the western range, and (2) the farm pasture.
4. (a) How does the age of the Aberdeen-Angus as a recognized breed compare with that of the Hereford? (b) In what country was the Aberdeen-Angus breed perfected? (c) When were importations of this breed made into the United States? (d) Compare the type of the Aberdeen-Angus with that of the Shorthorn. (e) Why are Aberdeen-Angus cattle better suited to farm pastures, in general, than to the rugged western ranges?
5. (a) What environmental characteristics of the native haunts of the Galloway breed have tended to influence its hardiness? (b) When were Galloway cattle introduced in this country? (c) Describe the Galloway type and compare it with that of the Aberdeen-Angus. (d) Why is the Galloway much more popular on the ranges of the far north than in the warmer range regions of the United States?
6. What breeds of dual-purpose cattle are popular in the United States, and what is their purpose?
7. What is the object of introducing the blood of Brahman or "Indian" cattle in our herds in certain sections of the South?

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CHAPTER XIV

JUDGING THE QUALITIES OF BEEF CATTLE

The ability to judge the qualities of cattle competently is essential to success in their production. Thorough knowledge of the art of judging is invaluable either in the breeding or the feeding of beef cattle. The breeder needs this knowledge in order to mate his individuals so that the offspring will conform as closely as possible to the ideal beef type. The farmer who is feeding cattle for the beef market also needs to know the points of a good feeder. He may authorize a commission company to buy for him, but he obtains more satisfaction and often more profit if he himself buys judiciously the animals he proposes to feed.

The Beef Type. — Cattle of the beef type are bred and developed for the production of meat. The ideal beef type is one that will produce the largest amount of the highest-priced cuts of beef when the animal is finished and butchered. For this reason those portions of the beef carcass from which the choicest cuts are obtained have been developed to the maximum. The value of a beef animal depends upon its possessing the right conformation and also upon its ability to develop into a desirable product at a minimum cost of production, under existing conditions and environment.

All the beef breeds are uniform in that they conform to the beef type. The individual in a recognized beef breed has a compact form, wide and deep throughout, with thick flesh; a straight, well-fleshed back, wide from neck to tail; a short, thick neck; heavy, well-fleshed shoulders; wide, deep, and full fore quarters; long, wide, and deep hind quarters; and a soft, elastic skin. A good animal of the beef type matures early and fattens easily.

Classes of Beef Animals. — Beef cattle may be divided into three classes: breeding cattle, feeders, and fat cattle. The same

general classifications apply to all three classes, the principal differences being the degree of perfection of the various parts. True beef form is of utmost importance in the breeding-cattle class, but there must also be assurance that the beef characteristics will be transmitted to the offspring. The best feeder animal is the one that gives the best promise of making the biggest gains in flesh at the least cost and of developing into a good beef form when fattened. Fat cattle are rated on their condition at the time of judging.

Feeders, being unfinished cattle, do not have the thickness of flesh covering that individuals in the fat class possess, but their general conformation should be the same as that of a finished animal. It is important that a feeder be hardy and have the appearance of being able to consume and convert into beef large quantities of feed. A large heart girth, a short, thick neck, and thickness and "blockiness" in general, indicate constitution in a feeder, while a pliable hide and soft, silky hair indicate a good quality of meat.

In the fat-cattle class, after conformation to type, the finish and quality of beeves are of first importance. Soft, silky hair, a pliable and rather thin hide, and fine bones in the finished animal, as in the feeder, indicate that it will dress out a large percentage of good-quality meat.

Breeding cattle, in addition to having the true beef-type conformation and qualities, must be prepotent or able to transmit to their offspring their usefulness and likeness. When the prepotency is strong and the line of breeding for a specific purpose is well defined, an animal should produce superior individuals. In a buli of this class the masculinity should be pronounced, while the female should show refinement. The shoulders and neck of the well-bred bull are heavy, while the cow has more barrel, and a longer body than the bull, with more length and width in the pelvic regions. The color markings should be typical of the breed, for trueness to breed type is indicated by them. As it is desirable even in the beef breeds for a cow to give milk enough to raise a calf, the udder and teat development should be normal.

Points of Beef Animal. — In order to judge cattle competently it is necessary to know the names and locations of the different parts of the animal so that the ideal for each part may be kept in mind. Familiarity with these can best be gained by studying the accompanying animal charts (Fig. 63). In the dressed carcass, the butcher uses names for the various cuts, as shown in Fig. 64.

Age Classification of Show Cattle. — In the judging of beef cattle there must be some standard as to age classes. The ages of cattle are calculated from September 1. Accordingly, all cattle born after September 1 in any year may be shown in the "under-one-year class" for the year when born and during all of the following year. Such animals would then be shown in the "under-two-year class" during the year following, and so on. Calves, however, are sometimes segregated into junior and senior classes. The junior class consists of all animals born between January 1 and August 31; the senior class must be born between September 1 and December 31, inclusive. A calf born on September 1, 1927, and shown in the fall of the next year would be a senior calf, while one born January 1 of the next year and shown at the same time would be classed as a junior calf. The same dates apply to junior and senior yearlings.

Age Classes of Purebred Beef Cattle. — The following age classification may be used for all breeds of beef cattle:

Bull 3 years or over.

Bull 2 years and under 3.

Bull 1 year and under 2.

Bull under 1 year.

Cow 3 years and over.

Cow 2 years and under 3.

Heifer 1 year and under 2.

Heifer under 1 year.

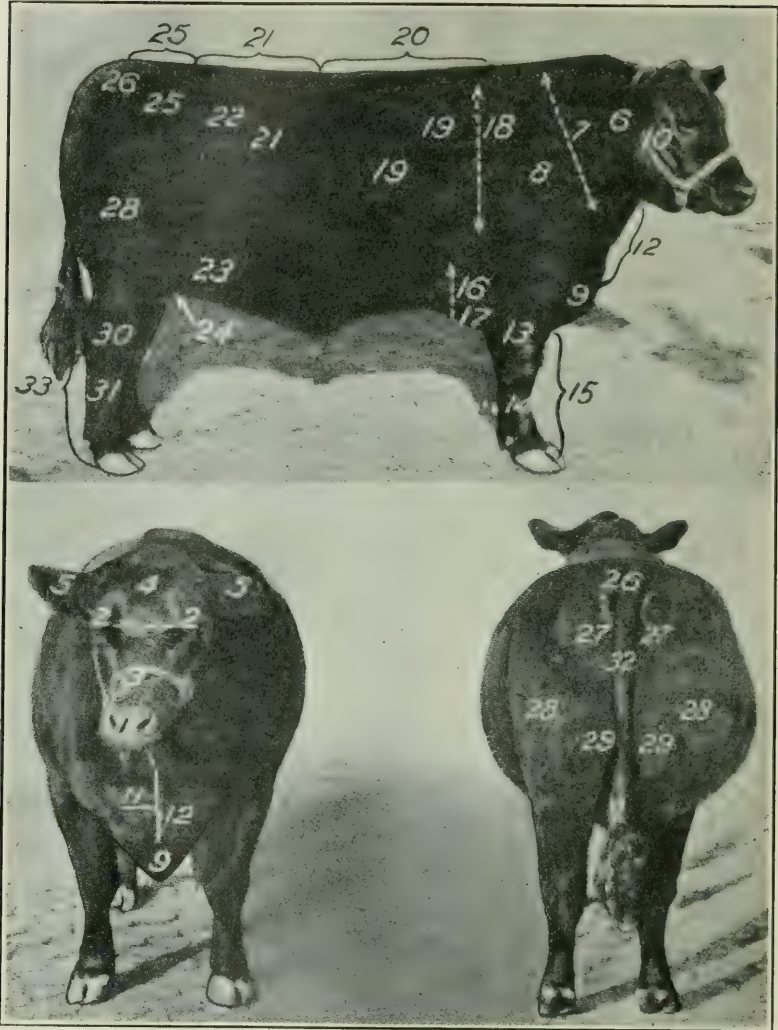
Champion bull, any age (only first-prize winners to be shown).

Champion cow, any age (only first-prize winners to be shown).

Get of sire — 4 animals got by same sire (sire need not be shown).

Herd — 1 bull and 4 females; bull, 1 year or over; females any age.

While the classes given above are designed primarily for purebred stock, they are often used in judging the qualities of high-



(U. S. D. A.)

FIG. 63. — PARTS OF THE BEEF ANIMAL.

- | | | | | |
|-------------------|---------------|-----------------|-------------------|---------------|
| 1. Muzzle. | 8. Shoulders. | 15. Foreleg. | 22. Hips. | 28. Thigh. |
| 2. Eyes. | 9. Brisket. | 16. Chest. | 23. Hind flank | 29. Twist. |
| 3. Face. | 10. Jaw. | 17. Fore flank. | 24. Cod or purse. | 30. Hocks. |
| 4. Forehead. | 11. Breast. | 18. Crops. | 25. Rump. | 31. Shank. |
| 5. Ears. | 12. Dewlap. | 19. Ribs. | 26. Tail head. | 32. Tail. |
| 6. Neck. | 13. Arm. | 20. Back. | 27. Pin bones. | 33. Hind leg. |
| 7. Shoulder vein. | 14. Shin. | 21. Loin. | | |

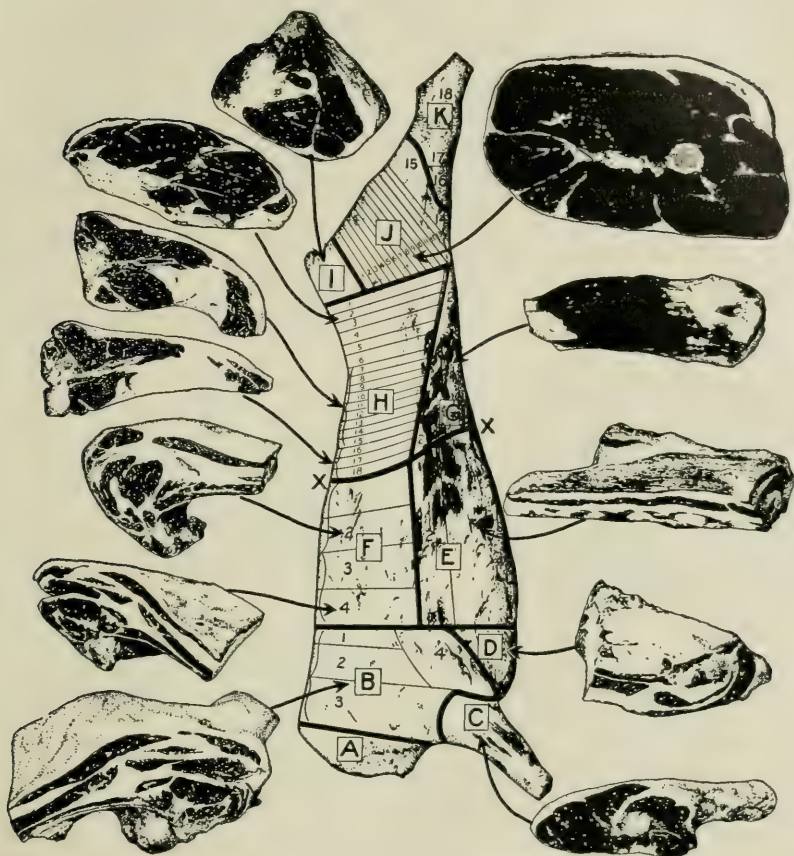


FIG. 64. — CUTS OF BEEF.

(X-X. Portion above this line is the hind quarter, while that below is the fore quarter.)

- | | |
|--|---|
| <p>A. <i>Neck.</i></p> <p>B. <i>Whole Chuck.</i></p> <ol style="list-style-type: none"> 1. 5th rib roast. 2. Chuck steaks. 3. Pot roast. 4. Clod. <p>C. <i>Fore Shank.</i></p> <p>D. <i>Brisket.</i></p> <p>E. <i>Plate.</i></p> <ol style="list-style-type: none"> 1. Navel. 2. Rib ends. <p>F. <i>Rib.</i></p> <ol style="list-style-type: none"> 1. 11th and 12th rib roast. 2. 9th and 10th rib roast. 3. 7th and 8th rib roast. 4. 6th rib roast. <p>G. <i>Flank.</i></p> <ol style="list-style-type: none"> 1. Flank steak. 2. Stew. | <p>H. <i>Loin.</i></p> <ol style="list-style-type: none"> 1. Butt and sirloin. 2. Wedge bone sirloin. 3. Round bone sirloin. 4-5. Flat bone steaks. 6. Pin bone steak. 7-15. Porterhouse. 16-18. Club steaks. <p>I. <i>Rump.</i></p> <p>J. <i>Round.</i></p> <ol style="list-style-type: none"> 1. First cut round steak. 2-13. Round steaks. 14. Knuckle soup bone. 15. Pot roast. <p>K. <i>Hind Shank.</i></p> <ol style="list-style-type: none"> 16-17. Soup bones. 18. Hock soup bone. |
|--|---|

grade cows, especially at county fairs where few purebred cows are available.

Age Classes of Fat Cattle. — As a rule, all steers — purebreds, grades, and crossbreds — should be shown together. Spayed or free-martin heifers should be allowed to compete with the steers. The age classes for steers are as follows:

Steers 2 years and under 3.

Steers 1 year and under 2.

Steers under 1 year.

Champion fat steers, any age (limited to first-prize winners in previous classes).

How to Tell the Age of Cattle. — For those who buy cattle from the grower, from a dealer, or in the stockyards where age records are not available, as well as for those who aspire to become expert judges of show stock, it is necessary to be able to determine the age of the animals. The age of cattle can be approximated by two means: by their horn rings and by their second incisor teeth.

Reading Horn Rings. — At about two years of age a somewhat inconspicuous ring appears at the base of the horn, and a second one develops at the age of three years. During the next few months these two preliminary rings fuse and all but disappear. Then a deep conspicuous ring forms to indicate the fourth year. Accordingly, to judge the age correctly by observing the horns, the smooth tip and the first inconspicuous ring should be counted as representing three years, and one year should be added for each additional ring.

Judging the age of cattle by the horns is often unsatisfactory because of the fact that the horns of show cattle may have been scraped and polished, and also because in many localities either hornless cattle are raised or the animals are dehorned. Therefore, it is much safer to rely on the teeth to tell the age story.

The Story of Incisor Teeth. — Cattle have eight incisor teeth, all in the lower jaw. In the calf, two or more of the first or temporary incisor teeth are in evidence at birth, the entire eight incisors appearing during the first month (Fig. 65).

As the animal approaches his second birthday, the center or

first pair of incisor teeth are replaced by a permanent set of incisors, or pincers, which at two years are fully developed (Fig. 65*a*).

Between two and one-half and three years the second set of incisor teeth, or "intermediates," appear, and at three years they are usually fully developed (Fig. 65*b*).

At three and one-half years the second intermediates or laterals appear, and at the age of four years they are on a level with the first intermediates. At the age of four, then, six of the eight permanent incisor teeth are fully developed (Figs. 65*c* and *d*).

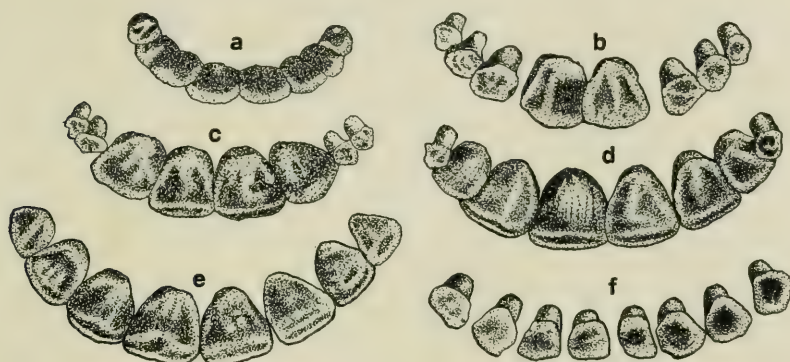


FIG. 65. — THE STORY OF THE INCISORS.

(See text for explanation of ages represented)

At the age of four and one-half years the fourth set of incisors replace the temporary corner incisor teeth, so that at five years of age the animal has a full complement of incisors with the corners fully developed (Fig. 65*e*).

At five to six years there is a wearing down or leveling of the permanent pincers, which are usually leveled at six years of age. At this time both pairs of intermediates are partially leveled and the corner incisors are showing some wear.

From seven to eight, pincers show appreciable wear; from eight to nine the middle pair are noticeably worn; and by ten years the corner teeth are well ground down.

After the tenth year the teeth become triangular in shape, spread widely, and show a progressive wearing to stubs (Fig. 65*f*).

QUESTIONS

1. (a) Why is it important to be able to judge qualities of cattle competently? (b) Why should the farmer who feeds cattle for the beef market be a good judge of cattle?
2. (a) Describe the beef type. (b) Into what classes are beef cattle divided? (c) How may feeders differ from the breed cattle?
3. Discuss the age classes of beef cattle relative to (a) the date when the age of cattle is reckoned; (b) calf classes; (c) yearling classes.
4. (a) Outline the age classes that are ordinarily used for all breeds of beef cattle. (b) What are the age classes for fat cattle?
5. (a) In judging the age of cattle, are the rings on the horns of any value? (b) How many incisor teeth do cattle have, and where are they located? (c) How many teeth has a calf that is one month old? (d) What is the condition of the mouth (teeth) when the animal is two years old? Three years? Four years? Five years? Six years? Nine years?

NOTE. — The bibliography for this chapter is placed at the end of Chapter XVII (page 295).

CHAPTER XV

RAISING CATTLE ON THE RANGE: THE BREED- ING HERD, BREEDING PRACTICES, PRO- DUCTION OF CALVES

The plan of management of the cattle herd adopted largely determines the success of the enterprise. It has been said that the cattle growers are not so aggressive in the adoption of improved methods of handling as the sheepmen. If this appears to be the case in some localities, it is doubtless due chiefly to two conditions — the difficulty encountered in the control of cattle on the range as compared with the ease with which bands of sheep are handled, and the fact that the investigations in range livestock management have been conducted more extensively with sheep.

The object of the following discussion is to emphasize and encourage the adoption of the best and most modern methods known in the handling of range cattle — methods that have stood the test well in practical beef production. The discussion is particularly intended for the young cattleman, upon whom largely depends the adoption, and to some extent the development, of improved management methods in future.

GENERAL RANGE METHODS

The handling of range cattle in different parts of the West varies somewhat according to climate, topography, and the forage; yet the principles upon which the management is based are the same. The individual cattle raiser, the cattle company, or the corporation usually owns some land which is suitable for the growing of grain and fodder crops. The range headquarters include a ranch house, sheds, corrals, a well or some other water supply, and certain other simple improvements. Those owners who have stretches of land along streams often control large areas of grazing lands adjoining their deeded holdings.

The numbers of animals owned by individuals or corporations and the amount of range land controlled per capita were formerly much larger than at present. In 1885, for instance, not less than 220 cattle raisers in Texas each owned from 1000 to 60,000 cattle. Most of the larger ranches of the bonanza cattle-raising period have long since been divided into smaller properties.

Spring and Summer Range. — The system of handling cattle on the range is comparatively simple, yet where the many requirements of the animals are looked after properly there is consider-



FIG. 66. — ON HIGHLAND PASTURE.

When the feed on the spring range has been consumed, the cattle are placed on the cool summer range.

able work. In the spring the cattle are held on the lower foothills where the earliest forage growth begins. As the season advances and the feed develops on the mountain range, the herd is admitted to the more elevated and usually more rugged lands¹ (Fig. 66).

By the end of June the cattle are usually located for the summer on the higher lands where the forage remains green and palatable until late in the season. As autumn approaches, the animals drift more or less of their own accord to the protected,

¹ The importance of grazing the various forage types at the right season is fully summarized in Chapter VI of this book.

less elevated grounds. Cattle are left largely to their own resources while on the range, but their welfare is generally looked after by experienced riders. It is the chief business of the riders to see that the cattle are kept on good feed; that they are herded away from areas infested with poisonous plants; that they are provided with sufficient salt of the right kind; and that they are prevented from straying too far from their particular range unit. The territory over which cattle travel varies in different parts of the country. They have been known, in a year's time, when unmolested, to work over an area 200 miles long.

Fall and Winter Range. — When the weather becomes inclement in the fall, the cattle usually leave the elevated summer ranges for the range which they occupied in the spring. Here little care is given, aside from riding to prevent the cattle from drifting excessively, and seeing that they have plenty of salt. On well-managed ranges the forage on the lower range is vigorous and fairly abundant when the cattle return to it in the fall. In winter, especially during stormy periods, cattle require more careful attention than in the other seasons. They are unlike horses in that they seldom learn to paw snow off the ground in search of forage, and they are inclined to drift great distances during blizzards and in cold weather.

In the early days of cattle raising there was little or no feeding of hay or concentrates; the animals were merely turned loose on the range to find their own living. The ranges which they occupied in the winter were in many instances those used for winter ranges at the present time. They are the lands of low elevation, and if the topography or the vegetation affords protection against storms the range is, as formerly, in great demand. In contrast to the times of pioneer cattle raising, however, some feeding is now done in most localities. This winter feeding is delayed as late as possible, for after the animals have once tasted hay or concentrates they are not inclined to rustle - their living exclusively off the range. Under yearlong range conditions, with no supplemental feeding, three-year-old steers, regardless of their breeding, are light in weight and inferior in

type, hence they must be sold as feeders or turned on good range for a year or more.

The Round-up. — Because of the large territory over which cattle graze, livestock associations usually work together, each rider being responsible for gathering the animals in a given part of the range. Two round-ups, one in the spring and the other in the autumn, are held each year. The spring round-up takes place between April and June, depending upon the earliness of the forage and the dropping of the calves. The object of this round-up is to get an accurate count of the stock and castrate and brand the calves; where the range can be divided, the breeding animals are separated from the steers and very young heifers. Each calf is given the same brand as the mother. All "orphan" calves are branded as "mavericks"² with a special mark agreed upon by the cattle association. When the maverick cattle are sold the funds are credited to the cattle association and used to pay for salt, branding, and other general expenses. The spring round-up requires considerable time because the cows and their calves must be separated from the herd in order that the ownership of the calves may be definitely established when the branding is done.

The fall round-up usually takes place in September and October, the purpose being to gather beef for sale and to brand the calves born since the spring round-up. This round-up is also handled under the general direction of the local cattlemen's association. The animals branded are credited to the respective owners, who are generally members of the association.

THE BREEDING HERD

Cows. — The western grazing grounds are often naturally divided into areas of varying size by mountain barriers, streams, or other topographical features. Advantage should be taken of

² One Samuel Maverick, a large stockman in Texas, was called to the colors during the Civil War, and his cattle were allowed to drift over the plains for several years. As Maverick did not return to his ranch, various stockmen gathered and sold his cattle. In rounding up these animals the stockmen put their own brands upon them and, in this way the word "maverick" originated, meaning anybody's animal.

the natural range divisions in the grazing of cattle, for the purpose of confining the animals more or less to a given area, especially during the main breeding season. The divisions vary greatly in size and support few or many cattle, according to nature's boundaries. A single cattle division is known as a "range" or a "range unit," and usually several men graze their cattle on one range unit.

It is of the greatest importance to keep the breeding herd in good, thrifty condition at all times. This can not be done if the range used by the breeding stock is overgrazed. Where the animals are run on the range the year long there will always be a few weak or thin cows. These should be given small quantities of concentrates or enough hay to keep them in a thrifty condition. All irregularly-breeding cows — those that bring a calf every other year or so, should be eliminated so that the herd as a whole will have a strong tendency toward regular breeding. Lack of constitution and low fertility are among the worst enemies in profitable cattle production. Cattle that breed part of the time are more likely to cause bankruptcy than are those permanently barren. The former are self-perpetuated, whereas the latter will come to a natural end.

Bulls. — It has been repeatedly proved that the practice of running on the range purebred bulls that are good individuals is economically sound. Such valuable bulls must be kept in good, thrifty condition at all times, and should be strong and in good flesh when the breeding season begins. This is possible, generally, only by feeding the bulls well during the winter and early spring.

The period of service of a range bull is considerably longer and he is more efficient if he is not permitted to run with the cows the year through, but is kept up during the non-breeding season. Sometimes it is important that the bulls belonging to an individual should serve his own cows only. Indiscriminate mixing of the herd usually tends toward breeding to inferior sires. Line riding, that is, keeping the herd in its proper territory during the breeding season by riders passing over the boundary of the range, will accomplish much in procuring efficient bull service. Natural

"box" canyons are often reserved with good results as breeding pastures. Wherever possible, breeding pastures on the range should be provided. Such areas should support an abundance of forage of good quality.

Without plenty of bulls a large calf crop can not be expected. Under farm conditions a two-year-old bull will serve thirty cows a year, and a three-year-old bull from forty to fifty cows. On rugged range, where the cows are widely scattered, it should not be expected that a bull will serve more than twenty cows during a normal breeding season.

In the consideration of the utility of range bulls and the percentage of calves secured, one can not over-emphasize the importance of (1) having on rough, unfenced range approximately five bulls to each hundred cows; (2) a breeding pasture for the cows, where possible, even where considerable initial expense for fencing is necessary; and (3) a definite breeding season.

Age for Breeding. — Breeders hold different opinions as to what age heifers should be before they are bred. Those who have achieved the best results maintain that female livestock in general should be nearly mature when the first offspring comes — from twenty-four to thirty months of age.

Among the probable evils of very early breeding are offspring with weak constitutions and below the average of the breed in size. Also the growth of the young dam may be checked somewhat when she is bred before she attains her full growth, and in many instances full growth is never attained.

Bulls are usually purchased when young and the temptation is to use them in service at an early age, particularly if they come from a family whose blood is greatly desired in the herd. From all viewpoints, however, it is a regrettable practice to use on the range bulls that are very young, for their maximum development is appreciably hindered. Only fairly young bulls should be turned out on the range, for they must not only be good rustlers of forage but they must also become familiar with the area of their domain. This requires one or two seasons. It is not until a bull has more or less established himself on a new range that he gives the best service. Yearling bulls are too young for service

on the range. Their growth is invariably stunted and the period of efficient service greatly decreased. Under the best of range conditions bulls lose their vigor at a comparatively early age. Their best period of service is about six years, when they are between the ages of two and eight years. Ordinarily, after the eighth year or so, the range bull should be replaced by a young animal. Sires with especially desirable traits, as in purebred herds, are usually retained in service until they are of an advanced age. So far as the range is concerned, however, the fact must not be overlooked that if there is a physical decline in the bull the percentage of calves secured is likely to decrease sharply. To avoid inbreeding, bulls are traded with stockmen whose ranges are remotely located.

Dethroning Scrub Bulls. — Beginning about 1912, stockmen in the western range states began drawing on breeders in the East for purebred cattle and other kinds of livestock. Until then there had been only a limited demand for the better purebred cattle.

For half a decade prior to this time there had been a law that every stockman turning cattle on the public-domain range must furnish at least one good grade bull for every twenty-five cows. This law, however, worked out like many others in the old days when the stockman ran his herds over unrestricted territory. The introduction of good sires was "left to George" and George was inactive. Those running only a few head of stock looked to the big owners to buy the blooded animals, and when a stockman purchased purebred sires it often happened that they were driven to a pasture of selected cows of the "nester" or parasite grower. Then, too, it was argued that scrub cattle were the only ones adapted to the range — that they alone could withstand the rigors of the winter and the droughts and heat of the summer. Moreover, most stockmen sold their steers by the head rather than by the pound, so that a scrub brought the same money as a grade or purebred. Why introduce purebred sires under such circumstances?

With the creation of the National Forests, which was accompanied by control of livestock on these ranges, the stockmen saw

an opportunity to improve the blood of their herds. Livestock associations, in which the majority rule, were organized in cooperation with Forest Service officers, for the purpose of holding council regarding the handling and improvement of the livestock. One of the first associations to take advantage of this "special rule" arrangement was on a Montana forest. Here the members of the Cattlemen's Association formulated the following regulations:

"All bulls then on the ranges of the association belonging to its members to be gathered, turned over to the advisory board and sold for the benefit of the association, each member receiving credit on the books of the association for the amount his bulls brought. Bulls belonging to non-members to be either sold as above or removed and kept from the range. A bull to be provided for every twenty-five cows of breeding age. All bulls used on the range hereafter to be purebred or registered. No bull to be over six years or less than eighteen months old at time he is turned out on the range, and no bull to be used on the range for more than three successive years. Bulls not to be turned on to the ranges before July 1 of each year or to remain on the ranges later than Oct. 1. The advisory board is authorized to purchase the bulls, all animals to be owned, distributed upon the ranges, fed and cared for and handled by the association as a body and replaced by the advisory board from funds in the treasury of the association."

The Forest officers did what they could to encourage these proposals as it was clear that they would greatly benefit the industry by increasing the weight of the cattle and the profits from them, and would be a start toward increased uniformity in the herd. This movement was so successful that the plan was soon adopted on other National Forests. By 1925 practically none but purebred bulls were found on the National Forest ranges of this country. There were in 1927 not less than 600 livestock associations in the West whose object, among other things, was to improve the grade of livestock.

Although most of the area embraced in the National Forests is available for cattle grazing only during the spring and summer months, the movement for improved blood on the National Forest ranges has spread to the unappropriated public domain and the private pastures throughout the West. The scrub bull on these great grazing grounds is passing with surprising rapidity.

Those interested in the development of livestock association "rules" will be impressed with the following statement which is part of the regulations that were adopted by an organization in Idaho in 1920:

"That all bulls turned on the range represented by the Horse Creek Grazing Association of the Targhee National Forest on and after May 30, 1920, shall be of the Shorthorn red strain. All bulls shall be registered, and registered papers shall be filed with the secretary of the association. Each permittee shall also file with the secretary the number of female cattle over the age of twelve months that he will run upon the range in the above allotment each year, prior to the time that he turns his cattle upon the range in said year. One registered bull shall be supplied with each twenty-five head or fraction thereof of female cattle turned upon the range over the age of twelve months, as provided by the Idaho State Bull Law. No bull shall be used more than two seasons. Permittees owning less than twenty-five female cattle over the age of twelve months may pool together, but in no case shall the number of females exceed the number above mentioned to each bull. In case a permittee has less than the number of female cattle to justify owning a bull, and does not own a bull, nor have any interest in one, such permittee shall pay into the treasury of this association the sum of \$2 as a service fee for each female over the age of twelve months."

Grading up the Herd. — It is financially impossible for all those who wish better-bred stock to purchase purebred cattle of both sexes. The alternative is to grade up their present stock by the use of purebred sires. As an offspring carries one-half of the blood of its sire, if this be pure, in four or five generations the progeny is for practical purposes purebred although not eligible for registration (Fig. 67).

To secure uniformity in range cattle and to obtain the best results from grading, sires of the same breed and preferably of the same family should be used; and the females selected for the breeding herd should be the ones which most resemble the females related to the sire.

Although the work of improving the quality of western range cattle has been making steady progress in the past two decades, much remains to be done. In many grazing regions the cattle are of low grade.

The most successful stockman knows that he can not afford

to keep scrub stock. He knows that the better-bred animal fattens more quickly, is more symmetrical when finished, hence commanding a higher price, and is ready for market earlier than the scrub.



(C. J. Belden.)

FIG. 67. — A ROUND-UP OF HIGH GRADE RANGE BEEF.

Animals of this quality are the result of selective breeding.

Although the influence of the remote ancestors counts, it should not be forgotten that with careful selection of sire and dam one-half the points of the offspring are within the control

of the stockman. In the next generation he controls three-fourths of them. This percentage increases until, if the type he has selected is not too complicated, he can control 90 per cent of the chances on a single given point. Good ancestry will not make a poor individual a good parent. The desirable animal is one that not only has good ancestry but is also a good individual. Experienced stockmen know well that it is much less costly to build up a herd by buying a well-bred sire, even when the expense for a single animal does seem disproportionate, than it is to raise the herd's level by buying better females.

The constructive breeder of range cattle buys the best bull he can afford, not, however, paying for fancy points, and each time he buys a somewhat better one. It is important that the grower build on one line of blood. When the blood lines are not changed with each purchase the improvement is quicker and more certain.

Prepotent sires of good blood are a requisite in improving a herd, but good females are also important, hence culling must be practiced continuously and with a rigorous hand. The breeder who is successful raises his standards with every generation and weeds out the weak individuals or those that are not of the desired type. This results in the best females being kept in the breeding herd. When the best are mated with superior males the resulting offspring is bound to be above the average of the herd.

Imported Animals. — In the beginning of breed history in the United States imported animals formed the nucleus in each breed, for it was in the older countries, England especially, that the breeds originated. Each year since has seen importations brought to America. These imported animals have helped supply sires for grading and have aided in maintaining the hereditary constitution of some of the breeds with the result that there have been smaller numbers of inferior animals in this country. Also the imported stock have provided new breeds, and have given America the benefits of European advancements in livestock raising.

Production of Calves. — The best herd of calves is one in which uniformity of age, size, and breeding predominates. The

most successful range cattlemen permit the bulls to run with the cows only during a definite breeding season. Where the bulls are with the cows throughout the year the uneven-aged calves that result do not have a uniform chance at the forage, and the supply of milk, which is also influenced by the character of the feed, is a factor of great importance.

The period of gestation in cattle is nine months. Accordingly, if the calves are to come in the spring or early summer the bulls should be removed not later than October 1, for then the latest calves will come early in July. Heifers should not be permitted to calve until they are from twenty-four to thirty months of age. They will usually mate at the age of six to twelve months, and if allowed to run with the bull they will calve so early that their growth will be more or less stunted. It is important, therefore, that the heifers be kept separated from the breeding herd from the time they are weaned until they are of breeding age.

An average of 78 per cent of calves is dropped among cattle herds on farms, but under the best of farm conditions the drop may go as high as 95 per cent. On the range the average calf crop is about 70 per cent. The percentage of calves largely determines the profits from the cattle business.

A summary of the chief factors concerned in a maximum calf production is as follows: (1) supplemental feeding of concentrates or suitable hay in the winter where the range forage is short or of poor quality; (2) abundant good range feed and water, and ample salt at all seasons; (3) efficient bull service; (4) a definite breeding season; (5) segregation of the breeding animals from the heifers and steers; and (6) the elimination of inferior, weak, or barren cows and of shy breeders.

The breeding season should be so arranged that the time in the year when the calves are dropped coincides with the inception of mild weather and abundant green forage. It is best to have the calves come as early in the spring as the climate and forage growth permit. Where suitable hay is abundant, however, the calves may be dropped before the season's forage growth has started. It is important that the calves make as much growth as possible before the fall pasture dries up. Calves dropped in August and

September under average range conditions seldom develop into as good animals as do those that come in April and May. The most serious setback to the late-born calves is likely to take place when they are taken from their mothers, for they are too young to rustle well for themselves when the earlier-born calves should be weaned.

Weaning Time. — Calves dropped in the spring should be weaned in the fall, preferably a short time before the forage becomes dry, usually early in October. Early spring calves should never be permitted to follow their mothers to the winter range. To avoid a setback the calves should be placed in a pasture where the forage is of the best, and held there for several weeks during the weaning period. The best practice is to feed the calves throughout the winter all the hay they will take. So-called "wiregrass" and other tough roughage should not be fed. On the other hand, slightly damaged, discolored, but not moldy, hay may be used. Where plenty of hay is not available and where the native forage begins growth early, as in the South, the Southwest, and California, the calves seldom need hay for more than two months, merely until they can be turned out on the green feed. Calves dropped late in the summer or in the fall need their mothers' milk throughout the winter, hence they should not be weaned until the following spring, when they should be placed on good green forage.

QUESTIONS

1. (a) What are the main duties of the riders in handling cattle on the spring and summer range? (b) On the fall and winter range? (c) In localities where supplemental feeding is necessary, when should the feeding season begin?

2. (a) What is a round-up? (b) How many round-ups are held each year and what is the object of each?

3. (a) How may efficiency in calf production be maintained in the range cow herd? (b) Is it good business to run purebred bulls on the range? (c) What is the period of efficient service of a range bull? (d) Should the bulls be kept with the cow herd the entire year? (e) How many bulls should be run with each 100 breeding cows on the average type of range?

4. (a) Why should range heifers be nearly mature when they drop the first calf? (b) At what age should young bulls be placed on the range?

5. (a) Discuss the effectiveness of the range law that provided for placing only purebred bulls on the range. (b) What effect have the National Forests and the livestock associations had in improving the beef blood of range cattle?

6. (a) Outline the most approved methods of grading up a range cattle herd. (b) What is the place of imported seed cattle in the improvement of the herds in this country at the present time?

7. (a) Discuss the factors to be taken into account in the production of a crop of superior calves. (b) For a maximum percentage of range calves. (c) At what age should range calves be weaned?

NOTE. — The bibliography for this chapter is placed at the end of Chapter XVII (page 295).

CHAPTER XVI

RAISING CATTLE ON THE RANGE (Continued): GENERAL HANDLING; WINTER HUSBANDRY

BRANDING, CASTRATING, AND DEHORNING

Branding. — The object of branding cattle is to establish definite ownership. Millions of cattle are turned out each year on the public-domain range, on the National Forests, or on unfenced private lands, and their ownership is known only by the brand which they carry. Without the brand, chaos would envelop the cattle industry of the West. Considering the wide expanse and ruggedness of the country over which the animals travel, remarkably few are lost to the owners. So efficient is the coöperation between the cattlemen, due largely to the organized efforts of the livestock associations, that the round-ups and segregation of the cattle are nearly perfect. Surprisingly few cattle which escape the ills of poisonous plants, animals of prey, or disease fail to reach the home ranch when winter comes, chiefly because of the system of branding. A well-established brand stands not only for ownership, but for the class of stock which the owner raises, the quality of the herd, the class of bulls used, the integrity of the owner, and his willingness to coöperate with his neighbors.

Open-range Branding. — Branding is a simple operation, the only difficult feature being to hold the animal securely. On the open range the cattle are usually roped by the neck or hind legs and dragged to the place of branding. As soon as the workmen throw the "critter" the rope is loosened so that the rider may bring forth another victim. The roping method of branding, however, is laborious, slow, requires some skill at rope manipulation, and is subject to some accident on the part of the men, calves, and horses. A large crew of men is required if there are many animals to brand in a short time. Because of the requirements of the animals for feed and water the operation must proceed swiftly.

Chute and Swivel-block Method. — A less romantic departure, adopted because of greater efficiency in handling cattle while branding, has been developed in southern California. The originator claims for this new method that he can brand, with a crew of five men, as many animals as he could with the help of twelve men when using the usual open-corral method.

The equipment calls for a chute and a 3-inch swivel block, fastened in the top of a concrete block or post set in the ground

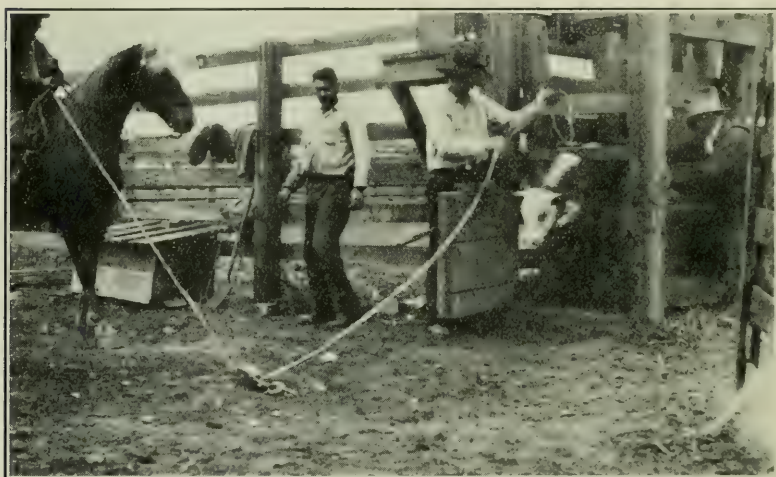


FIG. 68. — A CALF WALKING INTO THE OPEN NOOSE OF THE LARIAT AS HE COMES OUT OF THE CHUTE.

so that the top is flush with the surface. The lariat, which is passed through the block, is provided with a knot so placed as to prevent choking the animal. The end of the rope used on the hind legs of the animal terminates in a hook, hence a loop can readily be made around the hind legs of the animal when snubbed to the post (Figs. 68 and 69).

The advantages of this method are that the labor is greatly reduced and that the operation is easier for the men, the cattle, and the horses. Each animal is branded near the fire, where the branding irons and other necessary equipment are handy. The brand is clean-cut because the animal can not move, his head

being held securely on the ground by the rope through the block. Bruising or heating the cattle to be branded is almost entirely avoided. The equipment necessary to apply this simple method is inexpensive and can also be used for other purposes.

Squeeze-chute Method. — Some stockmen prefer the squeeze-chute for the branding operation. This equipment, although somewhat expensive, is entirely satisfactory for branding as its use tends toward speeding up the operation and is not likely to



FIG. 69. — STRETCHING OUT THE CALF AS HE APPROACHES THE SWIVEL BLOCK. The block has a swivel joint. The lariat, which is passed through the block, is provided with a knot to prevent choking of the animal.

injure the animals. The chute illustrated in Fig. 70 is of excellent design. It differs from the old-style chute in that the bars are upright instead of longitudinal, so that those interfering with effective work may be removed. With this chute the animal can be held with much less pressure than is necessary with the bars lengthwise, as the side bars fit snugly around the hips, ribs, and shoulders. As the animal becomes quiet he settles down in the V-shaped pit which fits him and supports him comfortably. The upright bars cause much less irritation than the longitudinal rods of the more common type of chute, for the latter bear down hard on the animal's frame.

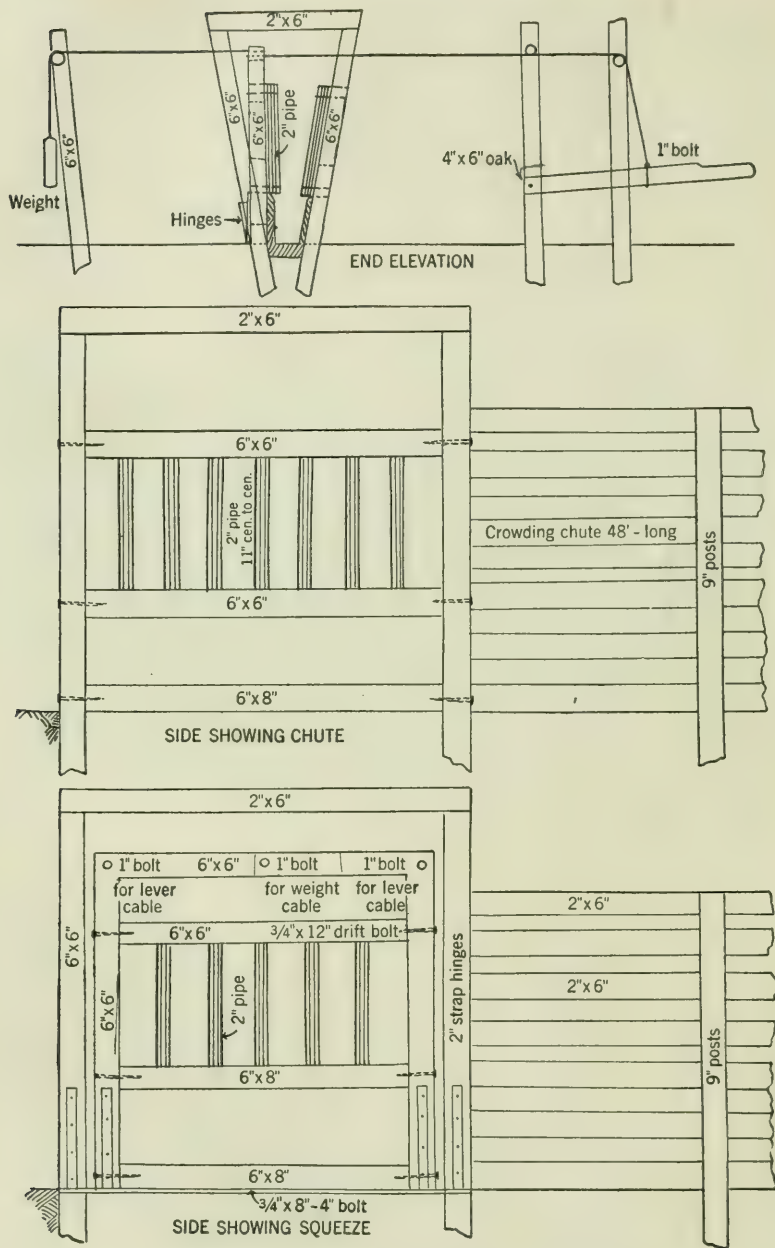


FIG. 70. — SQUEEZE-CHUTE, A REAL ASSET ON ANY RANCH.

The bill of material for a squeeze-chute of the design under discussion is as follows:

10	pieces	6 × 6-12 ft.	(posts)
9	"	6 × 6-7 "	(frame)
60	"	2 × 6-16 "	(crowding chute)
3	"	3 × 12-16 "	(floor)
1	"	3 × 12-8 "	(floor squeeze)
4	"	2 × 12-8 "	(side squeeze)
1	"	4 × 6-16 "	(oak lever)
12	"	2 in. pipe—3 ft. 6 in. long	
3	"	5 in. sheave wheels	
24	—	$\frac{3}{4}$ × 10 in. U bolts to hold pipe	
4	—	$\frac{3}{4}$ × 8 in. I bolts	
12	—	$\frac{3}{4}$ × 12 in. drift bolts	
4	—	2-ft. strap hinges	
40	ft.	$\frac{5}{8}$ in. cable	
50	lbs.	20d nails.	

Branding Irons and Their Application. — It is important that the branding irons be of simple design and of good size.¹ The

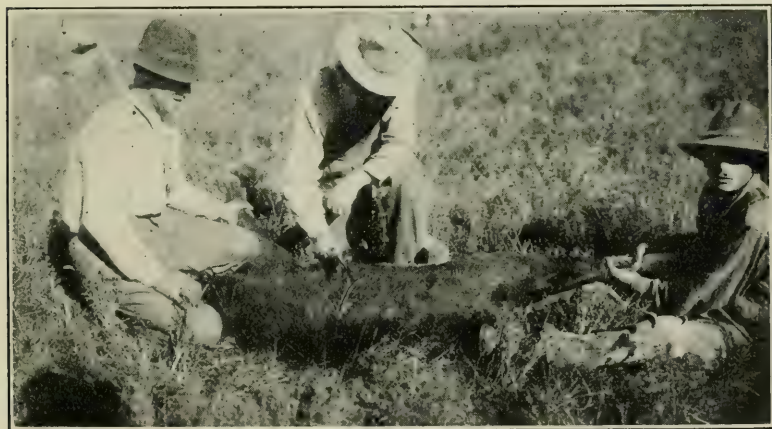


FIG. 71. — A PROPERLY MADE BRAND, THE "RING" IRON BEING USED.

"ring" branding iron and the "J" iron are equally popular in various localities, as either one can be used to brand any of the simpler designs. The "ring" iron is manipulated by means of

¹ Wilcox, W. F., "Brands and Branding in the West." *Breeders' Gazette*, pp. 638-641, April 7, 1921.

two wooden sticks about 12 inches long, which serve as handles. The "J" branding iron is one of the best for general use. A complicated brand is difficult to make and is not desirable. A brand should be not less than 7 inches high and at least half an inch wide (Fig. 71). Designs made of copper, although expensive, are best, as they retain the heat longer than iron. These designs should be comparatively heavy, of wide stock, and preferably of simple form.

When the iron is applied, it should be red hot, for otherwise the brand will be blurred. Cattle with long, thick hair require a much hotter iron than do those with short, thin hair. It is difficult to get the iron too hot, but if it is not hot enough it must be held on the skin so long that the tissues far beneath the surface will be deadened, resulting in subsequent irritation. On horses the brand from a hot iron is established almost instantly, but on cattle the iron must be held securely against the skin for a few seconds. The animal, as has been remarked, must be held very securely while being branded, for otherwise a clean-cut design can not be made.

Common locations for the brand are the sides, thighs, shoulders, and hips, the last probably being the most satisfactory. The brand should always be placed well up toward the back-bone, for otherwise when the animals are closely rounded up it can not be seen. Many stockmen brand on the heifer calves the last number of the year, with the regular brand design, in order to have a definite record of the age of the breeding herd.

Recording Brands. — Branding was originated in Mexico by the Spanish and French settlers, but Texas was the first state to establish a so-called "branding department." At the present time the brands must be recorded, in practically all the far western range states. One of the chief merits of recording the brand is to protect it from duplication. Where stock are run close to a state boundary the brand is recorded in the two states concerned. In Colorado, about 45,000 cattle brands were on record recently; in Montana, 60,000 brands are in active use; in Wyoming, 21,000. In California, 15,000 brands are recorded, which is about 75 per cent of the brands used. A fee of from \$1

to \$5 is charged for recording a brand, and \$1 is usually charged for transferring a brand to a new owner.

Other Markings. — In addition to the fire brands, various earmarkings and other markings are often used to identify the ownership of range cattle. Some of these are highly satisfactory because by them one can identify the ownership at a much greater distance than by a brand. This is especially true of the earmarks. Some of the most common earmarks are “crops,” “swallow forks,” “under-slopes,” and “under-bits.” Less common earmarkings are “flip-flops,” “under-seven,” “after-crops,” and “jingle-bob.” In addition, there are various distinguishing markings such as “buds,” formed by making a strip incision through the skin on the nose; “wattles,” made by cutting down a strip of skin on the jaw bone; and “dewlaps,” formed by cutting down a strip of skin on the brisket (Fig. 72).



FIG. 72.—DEWLAP MARKING OF A RANGE COW.

The dewlap can be seen at a much greater distance than the brand.

Castrating. — The calves are castrated when they are branded or marked, which is usually between the ages of one and four months. This operation is more or less crude, yet it seldom results in injury. A calf is never too young to be castrated — indeed calves castrated when very young never develop a “staggy” appearance.

The usual method on the range is to cut off the entire lower end of the scrotum, squeeze out the testicles, and draw them out far enough to cut off the cord.² Some cattle feeders object to having the end of the scrotum removed, as they prefer to judge the primeness of the animal for the block by the fullness of the

² Farley, Frank W., “Dehorning and Castrating Cattle.” U. S. Dept. of Agr., Farmers’ Bul. 949, 1918.

cod. Accordingly, some cattlemen cut vertical slits in the front of the scrotum, from which the testicles are drawn. Cutting off the end of the scrotum, however, has the advantage of perfect drainage. Where the bag is merely slit, good drainage is secured only when the slits are extended to the bottom of the scrotum. Occasionally a calf dies because of castration, but this is almost invariably caused by failure to use a disinfectant or so to operate as to insure good drainage.

Dehorning. — Dehorning cattle is almost universally practiced by stockmen who raise animals of quality. Cattle without horns have an equal chance at the feed in close quarters; they are easier to handle, and are more uniform in appearance. Moreover, without horns cattle can not gore one another at the feed, water, or salt trough, or in transit to market. Wounds cause shrinkage in weight, injure the hide for commercial purposes, and produce flesh bruises that detract from the value of the carcass.³

Various crude methods are employed in removing the horns, but the simplest, easiest, and most humane is to use caustic, either soda or potash, on the young calves. The best results are obtained when the caustic is applied to calves up to about two weeks of age. First clip the hair around the knobs where the horns are forming. With a moistened stick of caustic, obtainable at any drug store, rub alternately, three or four times, each embryo horn, allowing the caustic to dry each time before applying more. Care must be taken not to permit the caustic solution to run down over the calf's head, as this may cause blindness or severe soreness of the skin.

For older cattle either saws or clippers are used. The clippers are best for young animals whose horns are soft and tender, but for older cattle, whose horns are brittle, the saw is best. The operation is performed more quickly and with less pain with the clippers, but because this instrument often crushes the bone in the horn of the older animals, the wound tends to heal slowly.

Cattle should never be dehorned or branded during warm weather or in the midst of the fly season. Early in the spring is

³ Hickman, Richard W., "The Dehorning of Cattle." U. S. Dept. of Agr., Farmers' Bul. 350, 1909.

the best time. Either coal tar or pine tar applied to the wound will prevent fly injury. If screw-worms appear they may be removed by saturating a piece of absorbent cotton in chloroform and inserting it into the wound, or by pouring gasoline into the cavity of the horn. In order to make a clean, neat cut, the animal's head should be clamped or otherwise held in a firm position. For this purpose the squeeze-chute is invaluable.

It is a good practice not to remove the horns of range bulls so closely that they can not protect themselves adequately from steers or stags. A few inches of the sharp points, however, should be removed. With the points gone the bulls protect themselves but they can not so readily injure one another. Some stockmen prefer not to dehorn the breeding cows.

DISTRIBUTION ON THE RANGE

The first duty of those responsible for the animals or for the range is to control efficiently the number of stock on the range unit. Oftentimes the range as a whole may not be overstocked, but certain range units, or subdivisions, may be grazed excessively while other parts are understocked. It has been shown (Chapter VI) that if the number of cattle permitted on the range early in the spring is in excess of that which the area will support there is little chance of improvement in the stand of the forage, nor is the production of a maximum seasonal herbage crop possible.

Fencing to keep the animals from drifting on to certain parts of a range unit too early is the most effective remedy. If fencing is not practicable, organized, efficient riding should be resorted to. A combination of fencing and riding, in addition to a well-organized plan of distributing salt on the range, constitutes the usual means of cattle control.

Jardine and Anderson,⁴ working on National Forest range, have suggested the following guide which may well be followed in the control of cattle on any typical range unit.

1. To secure maximum production of stock on the range over

⁴ Jardine, J. T., and Anderson, Mark, "Range Management on the National Forests." U. S. Dept. of Agr. Bul. 790, pp. 32-33, 1919.

a period of years, some form of deferred and rotation grazing is imperative. Any plan for control of stock by units should provide eventually, therefore, for deferred and rotation grazing.

2. The segregation of breeding stock from dry stock on the range is an important item in the production of beef and will help to increase the calf crop.

3. Frequently there is great range in altitude and consequently great variation in the time at which different parts of the range on a single watershed should be grazed. Consequently, provision should eventually be made for dividing late spring and early summer range from midsummer and late summer or early fall range.

4. Boundaries of comparatively large units on ranges within the National Forests can usually be chosen so as to take advantage of natural barriers, high ridges, and streams, and thus minimize the fencing necessary to control the stock. On the other hand, distribution of stock is easier to obtain on small, controlled units than on large units.

5. Individual owners of stock naturally prefer to run their stock separate from that of other owners, and in many instances are prepared to construct fences for this purpose. Units to take care of individual permittees, however, interfere with proper management of the range and stock as a whole, except where the range of the individual is clearly a distinct natural grazing unit.

6. As a rule, the range lands are low in grazing capacity compared with farm pastures. Consequently, the number of stock controlled, rather than the acreage controlled per mile of fence, usually decides whether the cost of fencing is warranted or not. The exceptions are fenced areas for holding beef stock while they are being gathered, for purebred registered stock, for weaning calves, and for saddle stock.

SALT AND SALTING

Ample salt, put out at the right time and placed in suitable sites, constitutes the most influential single "tool" available in the efficient control and distribution of cattle. With plenty of salt, grazing animals develop better than without it, probably

because of its beneficial physiological effects and because the animals are more content, travel less, and are easier to handle.⁵

Amount and Kind of Salt. — The amount of salt that range cattle will consume varies with the kind of salt fed, the season of the year, and the climatic conditions. During the spring and summer when the forage is succulent — a period of about five months — 10 pounds of salt, or 2 pounds a month to the head, is not excessive. During the cooler, non-succulent forage period, less salt is required and ordinarily cattle will not devour more than about $1\frac{1}{2}$ pounds a month, or a total of about 20 pounds a year.

In many locations rock salt is used mainly. The chief objection to its use is that considerable time is required for cattle to obtain enough of such salt to satisfy the appetite. One or two cows may lick upon a chunk of rock salt for half a day, more or less, and keep other salt-hungry animals away from it. Crystal sack salt and compressed salt are also used on cattle ranges. Crystal salt, which is not to be confused with the ordinary finely ground dairy salt, is gaining in popularity because when it is properly distributed many cattle may get all the salt they require in a short time. In localities where the rainfall is heavy, however, the factor of waste is somewhat more serious where crystal salt is used. Hensel,⁶ studying the salt requirements of cattle on ranges of the Kansas Agricultural College, near Manhattan, found that the loss from all kinds of salt, except the granulated, was 11 per cent a month. At the end of four months, nearly 40 per cent of each grade was lost from weathering, or an average of approximately 10 per cent a month. There was less than 3 per cent difference in the weathering of the softest grades of block or compressed salt and the hardest, showing that so far as the action of the weather is concerned, it makes little difference which of these grades is used. These investigations emphasize strongly the need of good salt containers.

⁵ Chapline, W. R., and Talbot, M. W., "The Use of Salt in Range Management." U. S. Dept. of Agr. Circ. 379, 1926.

⁶ Hensel, R. L., "The Best Kinds and Grades of Salts to Use." *The Breeders' Gazette*, Aug. 11, 1921.

Salt Receptacles.—As a matter of economy, crystal salt should be fed in troughs, wooden boxes, or specially constructed salt receptacles. Where log troughs are used they should be so

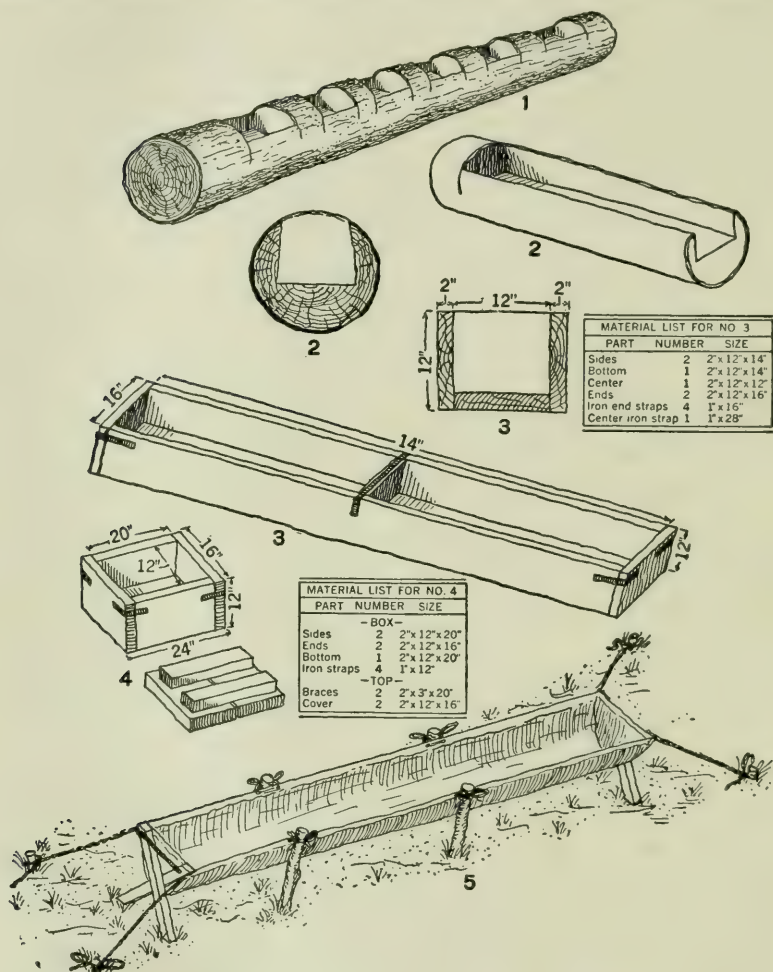


FIG. 73.—SALT RECEPTACLES FOR CATTLE AND SHEEP.

constructed that the top will be from 25 to 35 inches above the ground. Wooden boxes are also satisfactory, and if they are properly constructed, like the kind shown in Fig. 73, there is none better. Box troughs should have a tight-fitting lid, for

then any salt that remains when the animals are removed from the range may be reserved. Boxes of the type shown may be constructed at the ranch headquarters or some other convenient point and distributed on the range. Canvas troughs (Fig. 73, No. 5) are used occasionally on sheep bed grounds.

Distribution of Salt. — On every cattle range there should be a carefully developed plan to insure good distribution of salt, for the location and number of salting places have much to do with the uniformity of the grazing. A well-planned salting program should aim to correct the following practices, which, unfortunately, are often overlooked: (1) salting on the ground; (2) salting near water; (3) insufficient salting places; (4) salting on meadows, open areas, or other readily accessible places where the animals naturally congregate; (5) insufficient salting at any time in the season; (6) salting to hold the animals over-long on certain areas, and failure to salt with a view to getting uniform utilization of the range as a whole; (7) placing salt on over-grazed spots where a minimum of cropping should be permitted; (8) placing salt on poison-infested areas when losses are likely to occur.

The waste resulting from salting on the ground, especially where crystal salt is used, has been pointed out. Considerable argument has been advanced by some stockmen in favor of salting near water, chief of which is that the bulls may serve more cows when the animals are permitted to congregate about a common salt and watering ground. This contention is unfounded, for the biggest calf crop is obtained where the animals are uniformly distributed over the range and kept in the best possible flesh during the breeding and grazing season. The best gains are invariably made where the animals are well distributed over the range. Where salt is placed along the tops of the ridges from one-half to three-quarters of a mile from water, the range is grazed with remarkable uniformity. The cattle come down to drink, shade up, drink again, and then the exodus starts. Instead of trailing up and down the canyon for two or three miles the animals work out on the lower ridges and flats, spreading out fan-wise over the slopes, and spend several hours feeding as they

work to the top. Also, the small flats near the water are not badly depleted, as they formerly were from overgrazing due to salting near the water, but are soon revegetated, and there is ample choice forage everywhere.

The proper distance between the salt and the water depends chiefly upon the distribution of the water and the topography of the range unit. Ordinarily, on range of high grazing capacity, salt grounds should not be much more than half a mile apart on very rugged range, or more than about a mile apart on comparatively level lands. Obviously, salt should not be placed where the range is overgrazed or where there are poisonous plants. It should be located so that the depleted and objectionable range areas will receive only a minimum amount of grazing.

The amount of salt to be placed on a given salt ground should be based on the grazing capacity of the range. If, for example, an early spring range is estimated to support 100 cattle for a month, 150 to 200 pounds of salt should be left on the salt ground. In the autumn, if this same range would support 100 cattle for a month, approximately 100 to 150 pounds of salt would be required. On succulent forage the animals invariably require more salt than when grazing upon more or less mature dry feed.

A Properly Salted Range. — For convenience, salt grounds should be marked or numbered so that they can be referred to specifically. If a map of the range is available the salting places should be definitely located, preferably by number, on each range division (Fig. 74). In the case illustrated the salting grounds are not located more than a mile apart; none are located very close to water; they are so situated that the forage on the side hills and on other accessible range will be utilized uniformly; and there is just enough salt placed on each site to hold the animals sufficiently long to consume the season's forage crop. On the lower ranges the time at which the salt is placed corresponds with the time when the forage is sufficiently advanced for cropping. On the more elevated ranges the salt is likewise placed at a time to correspond with that at which the herbage is properly developed for grazing.

It is well to take advantage of the dry autumn weather in

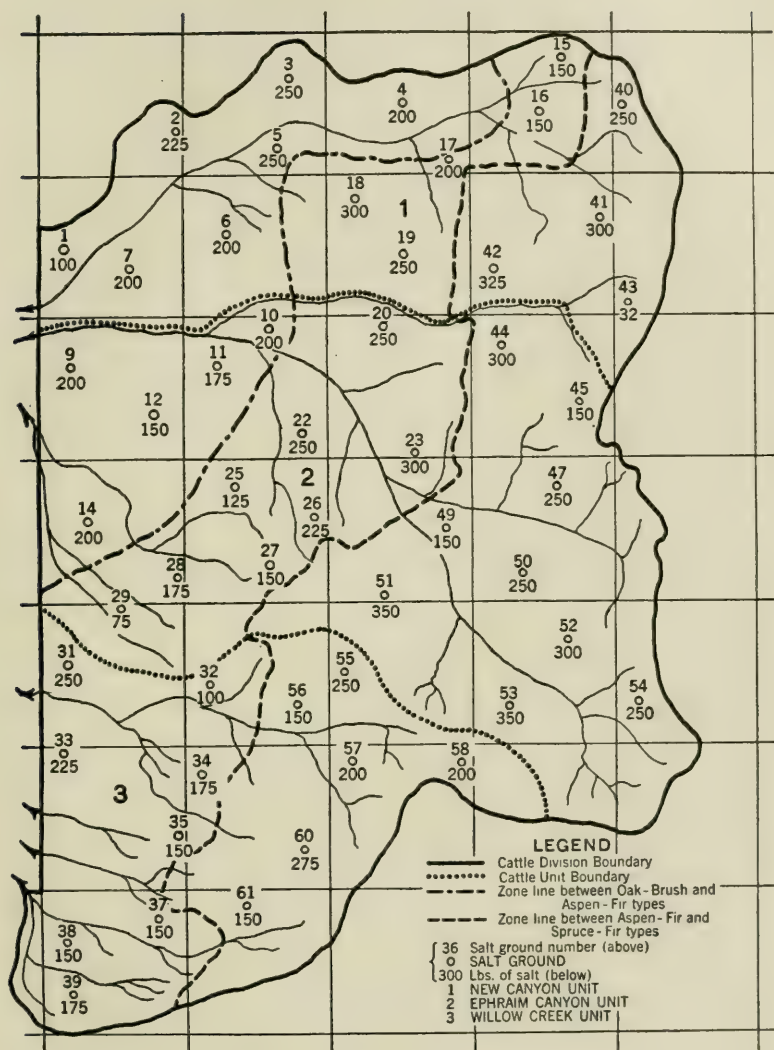


FIG. 74. — A PROPERLY SALTED RANGE.

Each salt ground is numbered and the amount of salt put out corresponds with the grazing capacity of the range. Section lines are shown.

bringing salt to the range for distribution in the spring. Many livestock associations and some individual stockmen construct inexpensive salt houses in which to cache the salt for spring use. This practice is commendable, for early in the spring the roads and trails are usually heavy and difficult to travel.

Responsibility for Salting. — On most public-domain lands several stockmen graze cattle in common. Such collective use of a range unit lends itself best to coöperative handling of all phases of the cattle-management operations, of which salting is a part. Usually the owners are organized into a livestock association. The association employs riders who look after the animals in all details, and haul and distribute the salt as directed by an officially appointed officer of the association. All expenses are prorated according to the number of animals each man grazes on that particular range unit.

If a range is grazed exclusively by one owner he must see to it that the salting and all other operations necessary in successful range husbandry are attended to. Generally, on public-domain lands, only very large operators have the exclusive use of a range unit.

WATERING

In regions of limited precipitation the distribution of water is often the primary factor in procuring efficient utilization of the forage. Under some conditions it is not possible to develop at low cost a sufficient number of watering places to insure full use of the forage. The best-known methods of water development and the proper distance between watering places on cattle ranges of different types are treated in a companion work.⁷

FENCING AND RIDING

Drift and Division Fences. — In the all-important control of the movements of range cattle, use is often made of so-called "drift" and "division" fences, especially on National Forest range. These fences, where well located, are of great value in

⁷ Sampson, Arthur W., "Range and Pasture Management." John Wiley & Sons, Inc., N. Y., pp. 296-298, 1923.

regulating the admission of the stock to the range, besides being effective means whereby the grazing of the various forage types which lie at different elevations can be controlled.

Drift fences do not ordinarily form enclosures but they may extend for considerable distances, usually from one natural barrier, such as a ridge, to another natural barrier. Their chief function is to keep the animals within a certain type, or zonal area, and to prevent drifting from one range unit to another. They may serve to prevent the animals from grazing upon poison-infested areas, but their main use is that of lessening the cost and increasing the efficiency of herding and gathering.

An example illustrating the use of a drift fence is furnished on the Fishlake National Forest in Utah. The fence was built to keep cattle on the north side and horses on the south side of a ridge, for on the south slope heavy patches of larkspur, a plant poisonous to cattle but not to horses, grew luxuriantly. In June, before the drift fence was built, but during the season of its construction, sixty cattle died. After the fence was built and the cattle were excluded from the larkspur areas, a loss of only five head occurred. It is estimated that this fence, which cost \$740, saved not less than \$2000 worth of cattle from larkspur poisoning the first year. Moreover, it is estimated that the grazing capacity, in addition to the higher efficiency in the use of the range, was increased approximately 50 per cent.

Division fences on the range serve chiefly to create community enclosures, that is, large pastures where individuals of a community of cattle growers may graze their stock without the animals drifting excessively. Such pastures, if properly subdivided, make possible judicious seasonal grazing, as well as deferred and rotation grazing. They also make it possible to segregate the breeding stock from the steers and young heifers. Drift fences sometimes serve the purpose of (1) protecting the young timber growth from destructive grazing; (2) holding stock during the round-ups; and (3) making possible greater efficiency in the handling of the stock in many ways. The initial and primary purpose of any fence on the range is to control the number of animals on the grazing unit. Once this is accom-

plished, division fences may be constructed here and there in accordance with the requirements for refining the management within the unit.

Range Riding. — While fences, good forage, and ample water are invaluable assets on a range, riders are also needed on large units. The main duties of the riders are to see that salt is put out at the proper time; that the watering places and fences are serviceable; that the animals are herded away from poison-infested areas; that any "bogged down" animals are removed and cared for;⁸ that dead carcasses are disposed of by burning or burying; and that many minor details are attended to as they present themselves.

Ordinarily, one rider with a good string of saddle and pack animals can look after from 300 to 1200 cattle, depending upon the character of the country and the grazing capacity of the range.

GENERAL WINTER HUSBANDRY

Winter and Emergency Feeds. — The cost of wintering cattle and other classes of livestock is sometimes a big item of expense in many localities. In some areas an abundance of cheap hay is produced, but in many parts of the range country ample hay is not available. In the northern sections where the winters are long and severe, and in the Southwest where periodic droughts are the limiting factor in the production of the range forage, the feeding of hay or concentrates is essential to success. In the northern states the winter's supply of range forage is often deep under the snow by November. The various hay crops, and such important concentrates as cottonseed cake, are in common use.

Silage Crops. — Most forms of silage contain between 65 and 80 per cent of water when they are fed. No nutrients are leached out, hence silage furnishes good, succulent feed which tones up the animal's system and stimulates the appetite. Where adequate cheap feed, such as hay, is available, the making of

⁸ In many parts of the West, streams or springs whose banks are lined with quicksand are very dangerous and stockmen are obliged to have their herders ride along the streams to save those animals that have been trapped in the "slow-but-sure-death dirt." The bog rider is busiest early in the spring.

silage is seldom profitable, but in many range regions, the silo goes hand in hand with profitable range livestock production.

Many different crops are used for ensilage purposes. A consideration of the comparative value of the more common silage crops, therefore, is of importance.

Corn. — Corn is the crop most widely grown for the silo. Corn silage combined with alfalfa hay forms a well-balanced ration, and the ensilage affords the desired succulence. Over a large part of the range country, corn matures sufficiently to make a good quality of silage.

Sorghum. — A large proportion of the nutriment of sorghum is in the grain. In the more northerly range region sorghum is not popular because climatic conditions do not favor the formation of the grain of the more common varieties, such as kafir and feterita, but in Texas and other southern states these crops are popular. Where the grain develops well, sorghum is a profitable crop and makes satisfactory ensilage. Pound for pound, sorghum silage is equal in nutrients to that of corn.

Sunflower. — The growing of sunflowers for silage is assuming large proportions both in eastern and far western states. The nutritive ratio of sunflower silage is 1 : 6, as compared with 1 : 5 for that of corn. The Russian sunflower is the most popular crop in the western states, where more than 20 tons of silage to the acre is sometimes produced. The sunflower plant matures early. In Wyoming, for example, the crop ripens in about seventy-five days. The time of planting sunflowers is about the same as for corn, between the middle of May and the first of June. The seed is drilled in to a depth of about 2 inches, the rows being 3 feet apart. On irrigated land the plants are from 3 to 6 inches apart in the row, whereas on dry lands they are spaced about 10 inches. The crop is cultivated like corn and is harvested for silage when the seeds have developed to the late milk stage.

From 10 to 15 pounds of sunflower silage may be fed per day to a cow or steer over long periods, but the best results are obtained where some alfalfa hay or cottonseed cake is fed with the silage. There has been some question as to whether heavy

feeding of sunflower silage might have an unfavorable effect on calf production. So far as has been determined, excellent calf crops have been obtained where large quantities of sunflower silage have been fed.

The place for growing sunflower silage is on ranches where sufficient roughage can not be produced for wintering the stock and where hay can not be grown cheaply. Where ample native forage or browse, even though not of the highest quality, can be supplemented by hay and some good concentrate to tide the animals over the more pressing season, the use of sunflower silage is of questionable economic value.

Sweet Clover. — Sweet clover, or melilot, is a biennial which is gaining in popularity for ensilage purposes in some sections of the West. The crop is siloed when the plants are about two-thirds in blossom. The silage is palatable to cattle and sheep, and as such the entire crop is utilized. Making sweet clover into silage, however, is recommended only where conditions prevent its proper curing and handling as hay.

Russian Thistle. — Russian thistle is a noxious weed widely distributed over the flats and foothills of the western grazing grounds. It is not proposed that the plant be seeded for silage or other purposes, yet where winter feed is scarce this thistle can be used in the silo. At the Nevada Experiment Station,⁹ Russian thistle has been estimated to have about 50 per cent of the food value of good alfalfa hay. The crop is cut for the silo with a mowing machine when the spines are forming. The ensilage is relished by stock and the animals do well on it, especially when given some alfalfa hay in addition.

Sugar Beets and Mangels. — Where the growing of sugar beets is successful, beets as well as mangels are used for silage. The mangel ordinarily produces about twice as much feed as the sugar beet, but owing to the higher sugar content of the latter it has considerably more food value, pound for pound, than the mangel. Comparatively speaking, harvesting the sugar-beet crop requires less labor, because the food value of this beet is very high. The

⁹ "Ensilage Crops for Nevada." Nevada Exp. Sta. Bul. 91, 1918.

beets are not siloed, but stored in pits like those used for potatoes. When fed, they are cut up in an ordinary food chopper.

Sugar-beet tops yield from 2 to 5 tons to the acre and make very satisfactory ensilage for cattle and sheep. The tops, like the underground parts, may be pitted instead of being siloed.

Soapweed. — The severe droughts which occur at intervals of from three to ten years in the Southwest have induced the stockmen in some parts of that section to provide against livestock losses by feeding soapweed silage in the winter and during droughts. Soapweed (*Yucca elata*), as it grows naturally, is grazed to some extent by cattle. The food value of this plant is much the same as that of the native forage grasses and some of the poorer hay crops.¹⁰

Only the plants of a height of about 35 inches should be cut. Soapweed ensilage, mixed with a small amount of cottonseed meal or similar concentrate, is satisfactory feed for range cattle. From 15 to 20 pounds of chopped soapweed to about 1 pound of cottonseed meal a day will maintain breeding cows in good condition. The cost of handling the soapweed from the time it is cut on the range, placed in the silo, and fed, is from \$2.27 to \$2.78 a ton.

The soapweed is found from western Texas to southern Arizona. It will probably gain in popularity as ensilage where supplemental feeding is practicable.

Handling Cattle during Drought. — Profits in cattle raising in the drier regions of the West are occasionally seriously reduced by periodic droughts which cause heavy losses among the breeding herd and the calves, and make difficult the improvement of the herd as a whole. Occasionally there are droughts of three or four years' duration.

Investigations in southern New Mexico¹¹ have shown that the grazing capacity of the better gramagrass ranges declines as much as 50 per cent when the drought is prolonged beyond the

¹⁰ Forsling, C. L., "Chopped Soapweed as Emergency Feed for Cattle on Southwestern Ranges." U. S. Dept. of Agr. Bul. 745, 1919.

¹¹ Jardine, J. T., and Forsling, Clarence L., "Range and Cattle Management During Drought." U. S. Dept. of Agr. Bul. 1031, 1922.

second year, and as much as 40 per cent of the grass cover is sometimes killed. Where 27 acres are sufficient in seasons of normal rainfall to maintain a cow for a year, 32 acres to a head are required to maintain an animal in fair condition during the first year of drought, 45 acres the second year, and 54 acres for each of the third and fourth years. Successful cattle production under such conditions is possible only by reducing the number of animals to conform to the grazing capacity of the lands. The safest plan is to confine the breeding herd to a number which the range will carry in poor years, which is approximately 50 per cent of the grazing capacity in years of normal rainfall. The surplus forage in good years may be utilized to advantage by holding over or buying young animals which may be disposed of in times of drought. In this way all of the range is made available for the breeding herd during the critical drought period.

The period of supplemental feeding may be reduced materially by reserving for use in the winter suitable grass range. In the Southwest this may be done most advantageously where tobosagrass occurs in the vicinity of the gramagrass type, for the former is best suited for summer forage and the latter is ideal for winter grazing. If the lands consist entirely of gramagrass or of similar types, the forage may be preserved for winter use by applying the deferred grazing plan on a portion of the range each season when the growth is normal.

QUESTIONS

1. (a) What is the object of branding and marking cattle? (b) How are cattle handled when the brand is applied? (c) Of what size and design, and of what material are the best branding irons? (d) Discuss the use of the iron with respect to the proper temperature when it is applied; the length of time the iron should be held on the animal.

2. What is the object of having a brand recorded?

3. (a) What markings, aside from fire brands, are used on cattle? (b) Describe a good squeeze-chute.

4. Describe two methods of castrating cattle.

5. (a) Why does it pay to dehorn range cattle? (b) Describe the dehorning operation in young calves; in mature cattle. (c) Should range bulls be dehorned, and if so, how? (c) At what season should the horns be removed? Why?

6. (a) Enumerate five important considerations that may well be followed in perfecting the control of cattle on a typical range unit. (b) What tools are available by means of which the number of cattle grazed and the distribution of the animals on the range unit may be controlled?

7. (a) What is the value of salt on the range aside from its direct physiological benefit to the livestock? (b) What amount of salt is consumed by cattle on succulent forage, as in spring and summer? On mature forage, as in the fall and winter? (c) What kind of salt is best suited to cattle?

8. (a) Discuss salt receptacles for use on the range. (b) In the development of a practical salting plan for a given range unit, what factors should be taken into account? (c) What factors should determine the time to put out the salt, and the amount placed?

9. Discuss fully the methods of salting and the conditions that you would expect to find on a properly salted range.

10. (a) What are the functions of division fences on the range? (b) How do the functions of division fences differ from those of drift fences?

11. (a) What are the chief duties of the range rider? (b) How many cattle can one rider husband?

12. (a) Is silage put up for the use of range cattle to any great extent? (b) What percentage of the total weight of typical ensilage is water? (c) Does the high moisture content enhance the value of silage as feed for cattle?

13. (a) How does the nutritive ratio of sunflower ensilage compare with that of corn? (b) How many pounds of sunflower ensilage are fed per day to mature cattle?

14. (a) Discuss sugar beets and mangels as stock foods. (b) Where is soapweed used as silage? (c) What is the cost of soapweed ensilage from the time that it is cut on the range until it is fed?

NOTE. — The bibliography for this chapter is placed at the end of Chapter XVII (page 295).

CHAPTER XVII

RAISING CATTLE ON THE FARM

The raising of cattle, whether it be baby beef, feeders, or prime mature animals, is a matter which concerns farmers in practically every section of the country. The profits to be had from cattle raising on the farm are determined primarily by the way the business is conducted, the efficiency of the breeding herd, and the feed, care, and general management given to the herd.

In the South, while cotton was the principal cash crop, little thought or attention was given to the raising of good beef cattle, although large numbers were produced. However, interest in the growing of good beef animals in the South was greatly stimulated about 1908, as the boll weevil became an important factor in cotton production. Now it is the belief of the southern farmer that cattle raising is practically indispensable to his farm operation, notably in maintaining the soil fertility and in utilizing the products that otherwise would be wasted.

It is only by means of a superior breeding herd that good calves, capable of rapid growth and of superior quality, may be expected. Special care, therefore, must be exercised in the selection of the cow herd, and in mating the herd with the proper type of bull, as well as in keeping the animals thrifty and healthy at all times.

The Cow Herd. — One often hears the remark, "Show me the breeding herd and the bull and I will predict not only the condition and quality of the calves, but the percentage of the calf crop."

There seems to be a mistaken idea among many farmers that good cattle are more or less of a luxury and not to be indulged in unless one's bank account is well developed. The sooner there is a change in this attitude on the part of the grower the sooner success will be assured. It is not generally realized that calves from good purebred beef bulls will average 100 to 150 pounds more in weight when a year old, than calves of the same age sired by scrub bulls, or by those of questionable breeding, and they

will usually sell for from 2 to $2\frac{1}{2}$ cents a pound more as stockers or feeders. At two years of age, cattle sired by good bulls, as compared with scrub sires, show an even greater spread in price than they do as yearlings. On the other hand, the cost of maintaining the breeding herd and the calves in fair condition is practically the same as for the better animals. The big difference in profits may be traced directly to the quality of the animals raised.

A good beef breeding cow should be alert but of gentle disposition, wide and deep-bodied, of good size, with a strong con-



FIG. 75. — FARM HERD OF SHORTHORN COWS ON BLUEGRASS PASTURE.

stitution, large girth capacity, and strong milking qualities. Cows possessing these qualifications will give good returns when maintained on suitable feed (Fig. 75). When bred to a good bull, such cows will ordinarily reproduce calves that will develop into superior animals.

The Sire. — Owing to the fact that the income derived from raising cattle is often only a minor part of the income on farms of the East and Middle West, the farmer is sometimes inclined to use inferior bulls.

The kind of a beef sire to select for the farm herd is the same as that recommended for use on the range, with the exception that the farm sire need not be as rugged or as heavy-boned. The desired type and qualities have been outlined in Chapter XV.

On pastures where there is abundant forage of good quality, one vigorous farm sire will serve forty to fifty cows as satisfactorily as a thrifty sire on the range will serve twenty-five cows. With this number a carefully planned breeding season must be observed.

A farmer who owns only a few cows naturally hesitates to pay the price of a good purebred sire. The remedy for inferior blood in farm communities where the cattle herds are not large is the coöperative bull association. Such organizations enable the owners of small herds to unite in the purchase of a good registered sire. In Europe the coöperative plan has existed for a long time and has given excellent results.

Some Advantages of Coöperative Bull Associations. — Most coöperative bull associations organized in the United States are composed of from fifteen to twenty-five farmers with a joint ownership of five bulls. The territory is divided into as many so-called "breeding blocks" as there are bulls, one bull being credited to each block. To avoid inbreeding, each bull is shifted to a new block every two years. If the five bulls live until each one has made a complete circuit, bull service of a high quality is provided for ten years. Each member of the association has the use of a purebred bull for many years at a cost considerably lower than that of a privately owned scrub sire. As a rule, the expenses which include the purchase price and the cost of maintaining the bulls, are distributed among the members of the association according to the number of cows owned by each member.

The more important advantages of the coöperative sire plan may be summarized as follows:

1. Fewer bulls are required by the coöperative plan than where they are individually owned, thus making possible the saving of much feed. In one association the scrub bulls used before the organization was perfected, according to their market value, were worth on an average \$89. The bulls purchased by the association averaged \$240. The cost to each farmer for the use of a good registered sire was \$14 less than his former investment in a scrub bull.¹

¹ Winkjer, Joel G., "Coöperative Bull Associations." U. S. Dept. of Agr. Bur. of Animal Ind., Farm. Bul. 993, p. 6, 1918.

2. Association sires usually increase the value of the calf crop greatly the first year. The improvement in the offspring clearly exceeds in money value the original investment in the sire.

3. The transfer of the association bulls from one breeding block to another at two-year intervals prevents inbreeding. At the same time line breeding may be carried out effectively and the introduction of blood of other breeds avoided. This tends to establish uniformity and increased efficiency in the herd.

4. Diseases are combated or held in check by the coöperative service plan. In the purchase of bulls, health certificates are required. Furthermore, farmers who do not dispose of cows that show a tubercular reaction are denied the use of the association bull. This regulation proves effective in eradicating disease.

5. Coöperative bull associations are highly educational. Neighbors become acquainted; they understand each other better; they meet and discuss their problems; petty jealousies are supplanted by a broad, progressive spirit; and each member is benefited educationally and financially.

These associations do not claim to give something for nothing; but they do pay a high rate of interest on the money invested. With an outlay of from \$25 to \$50 per member, the association can furnish the services of five purebred bulls. The daughters of the association bulls in a few generations will be practically equal to purebred cattle in meat or milk production.

HERD MANAGEMENT

Breeding up the Herd. — One of the most important phases of judicious management of the herd is to retain the best heifer calves each year to replace cows that are barren, those that are "shy" or intermittent breeders, cows of poor conformation, cows that fail to maintain themselves in good condition, off-colored cows, and those whose usefulness is declining because of age. Three systems of handling beef cattle are used more or less extensively, especially in the Corn Belt and the eastern states: (1) producing baby beef, (2) carrying the calves over as stockers for feeding at a more mature age, and (3) running the herd on the dual-purpose (beef and milk) basis.

Baby Beef. — Where the income is derived from the sale of baby beef, the calves are permitted to run with the mothers until they are about seven months old. At this age they should be weaned. Weaning should take from fifteen to twenty-five days. The calves to be sold as baby beefs generally receive better care because the fattening period begins at weaning time, and it is important to grow and fatten the calves as rapidly as possible, for they must be in prime condition when they are from fourteen to eighteen months old (Fig. 76). The production of baby beef



FIG. 76. — CALVES RAISED ON A CORN BELT FARM BEING FATTENED ON CORN AND CLOVER HAY.

is highly specialized and is confined to regions where an abundance of corn and other cereals, with suitable roughages, are produced. At the present time the Corn Belt is the biggest producer of prime young beef.

In the production of baby beef, it is of paramount importance to have cows of high fecundity to insure a regular calf crop. Cows fail to reproduce for many reasons, among these being heredity, diseases, poor feed, and certain other conditions that interfere with their proper development. Ordinarily, conditions that tend to reduce the number of calves, such as unsuitable or insufficient feed, or disease, are recognized and may be overcome. Inherent tendencies toward barrenness, however, are

little understood; indeed, barrenness appears so frequently that it sometimes baffles the most courageous and experienced breeders. Therefore, careful selection of cows that are useful cannot be over-emphasized. Regardless of the superiority of a cow, she should be eliminated without delay if she is an intermittent breeder or a non-breeder.

Super Baby Beef. — A comparatively new development in beef production, which is being used in various parts of the Middle West, is that of marketing super baby beef, or calves fattened under high pressure of feeding. The grower provides "creeps" for the suckling calves into which is fed a suitable grain ration. This plan makes possible the marketing in the autumn of the calves, in a high condition of flesh, directly to the packer. The early turn-over of the annual calf crop has distinct economic advantages.

Dual-purpose Cows and Mature Beef. — In the dairy and semi-dairy districts the dual-purpose system of production is popular. As soon as the calves are born they are taken from the cows and fed skimmed milk and supplemental feeds, for under this system the cows contribute to the dairy throughout the period of milk production. Care must be taken to select cows that are clearly of the dual-purpose type, for where this system is successful the strictly beef cow has no place. Calves from dual-purpose cows are seldom profitable in the production of baby beef as they do not possess, strictly speaking, the beef-type characteristics.

Season of Calving. — Regardless of the system of beef production, the breeding season may be so regulated that the calves will be dropped either in spring or fall, depending upon the local conditions. In either season care should be taken to have the calves come when the weather is not severe. The time of calving is best determined by the character and abundance of the feed, the shed space, and the labor involved. It is well to have all the calves in the herd uniform in size, and this requires that they all be born within a period of about sixty days.

Spring calves to be sold as baby beeves are usually not weaned until the fall, when they are put on feed. Some growers, how-

ever, prefer to wean the year's calf crop before the end of the fall pasture season so that the "youngsters" may get a good start while there is still some green feed. Fall-born calves should not be weaned until good green forage is available in the spring.

Care at Calving Time. — If the cow is healthy when the calf comes, little if any assistance is necessary. Many a calf, however, is saved by removing the fetal membrane from the nose and mouth as soon as it is born. If breathing is intermittent, pressure on the ribs is helpful. It is sometimes necessary to assist a calf to find the udder. This is important, as the calf should get the first milk, containing the colostrum, which acts as a mild purgative. Ordinarily, the calf should have all of the milk that its mother produces if it is to grow rapidly.

Dehorning, Castrating and Branding. — Since farm-grown calves sooner or later reach the feed lot, they should be dehorned and branded, and the males castrated before they develop sexual instincts and a staggy appearance. The three operations are sometimes performed at the same time, preferably well before the calves are weaned. These operations, described in Chapter XVI, are comparatively simple and if performed properly there is little setback and practically no loss resulting therefrom. Branding or earmarking farm cattle, although of less importance than it is on the open range, is a good practice. It simplifies the separation of accidentally mixed herds and makes far easier and more accurate identification of animals shipped or sold co-operatively.

Equipment and Shelter. — The equipment and shelter used for protection against inclement weather varies widely in different sections of the country. In the East and Middle West, barns or open sheds, located in well-drained places, are necessary (Fig. 77). Usually large quantities of hay or silage are stored in or near the barn so that the stock can be fed under shelter in severe winter weather. Trees planted for protection from the wind are also helpful where the winters are cold and high winds are of common occurrence. In the South, provision need be made merely to keep the animals dry when at rest.

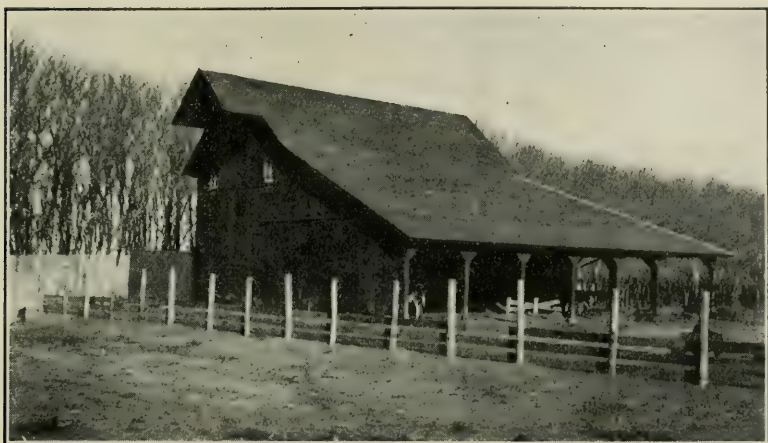


FIG. 77. — PROVISION OF BARNs OR OPEN SHEDs, LOCATED ON WELL-DRAINED GROUND, IS ESSENTIAL WHERE THE WINTER IS COLD AND WET.

Note trees in the background which serve as protection against wind and afford shade during hot weather.

RAISING CATTLE VS. BUYING FEEDERS

Breeding Market Cattle on High-priced Lands. — Considerable diversity of opinion exists among stockmen and farmers as to the comparative merits of raising and growing one's own feeders on land worth \$150 or more an acre, as in the Corn Belt, or purchasing good western raised feeder cattle. Feeders, if purchased, are usually either bought in the fall, roughed through the winter, and placed on good grass pasture in the spring, when they are gradually given a fairly heavy grain ration, and sold in the summer, or they are bought when the spring pasture becomes available and yard fed for high finish the following winter.

There is doubtless an argument in favor of raising one's own feeders, as well as of disposing of the cows and thereby conserving all the feed for purchased feeder cattle. Everywhere there is a distinct tendency toward marketing cattle at an earlier age than was formerly done. Three, four, and five-year-old steers, which were common on the market a few years ago, have been almost entirely replaced by yearlings, two-year-olds, and a few three-year-old steers. A number of causes have brought about this

condition, but chief of these is the fact that the returns from the sale of young animals are proportionately greater than when they are held over to maturity.

Americans, per capita, are consuming less meat than they formerly did. The decreased size of the American family has created a demand for the smaller cuts; hotels and other public eating places are also buying smaller cuts, because they now receive about the same price for a medium-sized steak as for a large one (quality again having won over quantity). Lastly, financial conditions have tended to force the grower and the feeder to turn over his products as quickly as possible.

The investment in the cow herd is considerable, and the fact that a certain percentage of the choicest female calves must be retained to replace the breeding cows tends towards high production costs. Where the feeders are raised on cattle land they must be marketed at an early age. As long as good quality beef-bred calves, weighing 400 pounds or more at weaning time, can be purchased in the Corn Belt and in the East for \$30 to \$35 a head, it is not probable that the number of beef breeding cows will increase appreciably in those regions. This prediction is made in spite of the fact that the carrying capacity of the high-producing lands east of the Great Plains has been greatly increased in recent years through the introduction of such fodder crops as sudan grass and sweet clover, and the more general use of siloed roughages. Some farmers of the Middle West and East feel that they may well continue to maintain a few beef breeding cows in order to utilize such crop residues as are not suitable for fattening purposes. Others contend that they would rather put young feeder stock on such land in order to take advantage of their rapid growth and at the same time build up a good frame for the feed lot later.

The demand for young feeder cattle in the farming region here considered has increased so rapidly that many western cattle growers have practically abandoned their steer herds. In their place are breeding cows. The advantage of the more rapid turn-over is favorable to the producer, the feeder, and the ultimate consumer.

Breeding Purebred Cattle on High-priced Lands. — One of the first essentials in the breeding of superior cattle is an abundance of good feed. For this reason highly productive lands are indispensable for raising purebred cattle. In addition to the fields where the feed is grown and the stock grazed, a well-drained and protected barnyard site, suitable barns, corrals, and other improvements are also essential.

Probably as important as the physical plant in the raising of purebred cattle is the matter of the adaptability of the person engaged in the enterprise. Those who possess natural ability in this fascinating field will make a much greater success than will those who are not so gifted. Those who have made a real success of the breeding of seed cattle have acquired intimate knowledge and experience by personally handling the animals, for only by knowing every individual in the herd is one able to mate the individuals successfully. Not only should the breeder know the strong and weak points of each individual but he should know their ancestry so well that he can tell from which progenitor a particular point came. If, together with this keen power of observation, which is partly acquired and partly natural, the breeder can visualize an ideal type of animal toward which to work, he has two important requisites for attaining success. He should also understand the laws underlying the principles of breeding, for through their proper application grave errors in mating may be avoided, weak features eliminated, and prepotency strengthened. A master breeder must have a receptive and creative mind.

Another essential in the successful production of purebred livestock is the ability to judge the qualities of an animal correctly. Raphael, the noted painter, when asked to define his vocation said, "Art consists in the ability to see." The art of judging livestock consists in the ability to see every important point about an animal in its true light. No successful breeder can overlook or disregard the qualifications of his stock, nor can he mate the animals more or less indiscriminately, and maintain a herd of uniformly high-grade cattle.

FEEDS FOR THE FARM HERD

Winter Feeds. — During the winter the cows, especially those with suckling calves, while being fed mainly on inexpensive roughages, should have enough succulent feed each day to promote a sufficient flow of milk. The ration as a whole should be reasonably well balanced and should consist of some leguminous forage as well as wild hay, straw, and other available feeds. Cows that are being milked should be given feeds suitable for dairy herds, but the major part of the ration should consist of inexpensive home-grown feeds. In the South the velvet bean makes excellent pasture for cows both in winter and summer. On farms in the Southwest a goodly supply of silage and cottonseed meal or cake should be on hand. The crops commonly grown for silage have been enumerated in Chapter XVI.

The comparative value of certain winter feeds for young cattle is well illustrated by the results of a 150-day winter-feeding test conducted in Nebraska.² Although prairie hay, which is no longer widely available, was used, the results are applicable where most grass hays are fed with similar rations.

WEIGHT, GAIN, AND COST OF CALVES DURING A WINTER FEEDING PERIOD

Weights and Gains of Calves	Lot 1	Lot 2	Lot 3	Lot 4
Initial weight per calf, lbs.....	322.5	322.6	322.6	322.5
Final weight per calf, lbs.....	347.9	497.1	513.5	477.9
Total gain per calf, lbs.....	25.4	174.5	190.9	155.4
Daily gain per calf, lbs.....	.17	1.16	1.27	1.04
Daily ration, lbs. per calf:				
Prairie hay.....	9.1	12.1	11.3	.....
Cottonseed cake.....	.....	1.0	1.5	.....
Mixed hay.....	.....	.....	.....	12.6
Feed required per lb. gain:				
Prairie hay, lbs.....	53.7	10.4	8.88	.....
Cottonseed cake, lbs.....	.....	.86	1.18	.....
Mixed hay, lbs.....	.....	.....	.....	12.2
Feed cost per 100 lbs. gain.....	\$21.48	\$5.67	\$5.61	\$7.58
Feed cost per calf — 150 days.....	\$5.46	\$9.89	\$10.71	\$7.58

Feed Prices: Prairie hay @ \$8.00; mixed hay @ \$8.00; cottonseed cake @ \$35 a ton.

² "One Hundred Fifty Day Calf Wintering Project." Nebr. Agr. Exp. Sta., Div. of Animal Husbandry (Mimeographed), 1927.

The calves had been on test 150 days. As shown by the table, those in Lot 1 made an average gain of 25.4 pounds. They were potty, rough-haired, and made an unthrifty appearance. The calves in the other three lots gained from 155 to 190 pounds, and were of uniform appearance, growth, and vigorous-looking. The calves in Lots 2, 3, and 4 were not too fat to gain rapidly in the spring on green grass without grain or supplement.

From these tests it is evident that prairie hay without supplemental feeding is not a satisfactory ration upon which to winter-feed weanling calves. The fact that these calves consumed 53 pounds of prairie hay to produce 1 pound of gain shows that hay alone is not economical. In Lot 2, 10.4 pounds of hay and 0.86 pound of cottonseed meal produced 1 pound of gain. In other words, the addition of cottonseed cake at the rate of 1 pound a day saved 45 pounds of hay in producing 1 pound of gain. On this basis the cake is worth considerably more than its cost price. It is interesting to note that the steers in Lot 1 took only 9 pounds of hay per day, whereas those in Lot 2 consumed 12 pounds, in addition to 1 pound of cake. The cake increased the appetites of the calves and caused them to consume a total of 4 pounds more feed daily.

The small gains made by the calves when fed only prairie hay emphasize the importance either of feeding leguminous fodder with the grass hay or some concentrate like cottonseed cake.

Comparative Value of Farm Feeds. — To insure rapid growth and good development of bone and frame in young stock, and vigor, health, and adequate flesh in the breeding herd, a reasonably well-balanced ration is more important than it is sometimes believed to be. Satisfactory rations may usually be obtained by feeding the products grown on the farm in suitable proportions. The amount of the various roughages and concentrates fed must be regulated by the cost and the food value of each. The following summary of the food value of the more common farm feeds should, therefore, be helpful in using each to its best advantage as feed for young animals.

Wheat, Corn, and Barley. — These are of practically equal

value per pound for livestock feeding, if they are properly balanced with other foods.

Kafir Corn. — While kafir corn is of nearly the same composition as corn, it is not generally as palatable to cattle. Five pounds of ordinary corn is equal in food value to about 6 pounds of kafir corn.

Corn Bran. — The bran from corn is not as palatable as that from wheat and is worth only four-fifths as much for feeding.

Oats. — The value of oats has been much over-estimated. One bushel of corn contains twice as much nourishment as 1 bushel of oats, while on the pound basis shelled corn is worth a little more than oats.

Wheat Shorts. — The by-product, wheat shorts, is worth from \$1 to \$2 more per ton than wheat bran because it contains a slightly higher percentage of protein and carbohydrates.

Cottonseed Meal. — Cottonseed meal, compared with bran, contains three times as much digestible protein and about the same amount of digestible carbohydrates and fats. For feeding it is worth twice as much as wheat bran, and for balancing a corn ration it is worth three times as much as corn bran.

When the contents of a bag of cottonseed meal are given in terms of nitrogen or ammonia, and the feeder desires to know the protein content, he may determine it by using the following factors:

If the analysis is given in terms of nitrogen, the protein content is obtained by multiplying by 6.25. Thus a 100-pound bag of meal with the nitrogen content of 5.50 per cent would contain 5.50×6.25 , or 34.37 pounds of protein. Where the analysis is given in terms of ammonia, the protein content in a 100-pound bag of cottonseed meal is obtained by multiplying by 5.15. Thus 100 pounds of cottonseed meal containing 8 per cent of ammonia would contain 41.2 pounds of protein, or 8×5.15 . This would be a fairly high-grade meal.

Cottonseed Hulls. — This roughage is of less value than well-cured stover (corn fodder) or oat straw because the animal can digest little of it.

Linseed Meal. — Although there is a little less protein in

linseed meal than in cottonseed meal, when given with other feeds it is about equal in food value to that of cottonseed meal. It is valuable too because it has a soothing, beneficial effect on the bowels of the animals.

Soy Beans. — Of all the farm-grown feeds, soy beans contain the largest amount of protein. There are 3.1 pounds of crude protein in every 10 pounds of beans. Moreover, they are rich in fats. Because they contain such large quantities of protein and fats, only small amounts should be used in a ration. They have nearly the same value for feeding as cottonseed and linseed meal.

Soy-bean Cake. — Pressed or cake soy bean has a slightly higher food value than the meal, especially for dairy cows. It contains slightly more protein than the meal.

Alfalfa Hay. — Alfalfa hay is rich in lime and if well cured it is about equal to bran for feeding purposes. If fed too liberally it may prove laxative but this effect can be checked by changing the ration for a short time, to timothy or wild hay, or a combination of these with alfalfa.

Clover. — Pound for pound, clover hay as a feed is slightly superior to alfalfa. Furthermore, clover hay is not as "stemmy" as soy-bean or cow-pea hay.

Timothy and Wild Hay. — These hays are somewhat more palatable than oat straw, but in chemical constituents the three are similar, being comparatively low in protein. Timothy or wild hay with clover gives good results.

Corn Silage. — Silage from corn is worth from \$6 to \$9 a ton when used for finishing steers. With dairy cattle of good milk-producing ancestry the value is still higher. Cottonseed meal given in medium amounts is often used to supplement corn silage in a fattening ration.

Corn Stover. — Feeding experiments show that 1 ton of well-cured corn stover is worth about three-fourths as much as 1 ton of timothy hay. It is equal in value to cottonseed hulls as a roughage feed. The stover must be well cured, however, to have this food value. If left in the field it soon loses some of its nutriment.

Straw. — Neither wheat nor oat straw, when fed alone, is suitable roughage for cattle. Combined with corn silage or some leguminous hay, good use can be made of such straw but ordinarily it should not constitute more than about one-half of the ration of stocker cattle. Straws rank in value for feeding in the following order: oat, barley, wheat, rye.

The value of straw depends largely upon the way it is harvested and cured. Oat hay cut before the grain is ripe, but after it is well formed, is almost as well liked by animals as clover or alfalfa. When such grain straw can be purchased at about one-third the cost of alfalfa or clover hay it is worth the price.

Rape. — Rape has a high place in the list of feeds for certain animals. Where the growth is heavy, especially if fed with some grass, lambs may be fattened on it without grain or other concentrates. Cattle also do well on rape. September and October are the months when the rape is most valuable for pasture. The animals should gradually be accustomed to rape in their ration. This may be accomplished by letting them feed upon rape pasture at first only an hour in the middle of the day when the leafage is dry. The grazing period is then increased gradually until in ten days or so the animals can graze exclusively upon rape pasture without danger.

Root Crops. — The water content of root crops is so high that 3 to 4 pounds are required to equal in food value 1 pound of corn. The heavy feeding of root crops also requires the feeding of grain or other suitable concentrates. Root crops are highly valuable in keeping the digestive tract in good order. They are especially desirable for the feeding of dairy cows. The roots should be cut or chopped before feeding.

Beet Pulp. — Beet pulp when dried is about equal to corn for fattening purposes. The wet pulp is utilized to good advantage in beef production and in the fattening of old ewes.

QUESTIONS

1. Upon what factors does profitable cattle raising on farms chiefly depend?
2. (a) Why were cattle in the South notably inferior and relatively

unprofitable prior to about 1908? (b) What condition has been chiefly responsible in recent years for more rational cattle raising in the Cotton Belt?

3. Enumerate the points desired in a good cow of the beef breed.

4. What quality of foundation cows should the beginner buy?

5. Discuss fecundity in the foundation cow herd and methods of maintaining high breeding efficiency.

6. Name and discuss the three common systems of growing beef cattle in the different farm regions.

7. Discuss the equipment and shelter necessary in cattle raising in the different farm regions.

8. (a) What part have coöperative sire associations had in improving the breeds of cattle on farms east of the Great Plains? (b) How is such an association operated?

9. (a) What farm conditions are essential to success in the production of purebred cattle? (b) Discuss the personal equation in connection with the successful raising of purebred cattle.

10. (a) What feeds may be used for the foundation cow herd in winter in the North? In the South? (b) Compare the feeding value of a good quality of oat straw with that of timothy and wild hay; with alfalfa hay; with kafir corn. (c) How does the protein content of cottonseed cake compare with that of bran? (d) Do cottonseed hulls have any feeding value?

11. (a) How do the nutritive qualities of clover hay compare with those of alfalfa hay? (b) Compare the feeding value of corn stover with that of timothy hay; with that of cottonseed hulls. (c) How does dried beet pulp compare in feeding value with corn?

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CHAPTER XVIII

COMMON DISEASES OF CATTLE AND THEIR CONTROL

It is almost unbelievable that 20 out of every 1000 cattle die each year from disease, yet this is the average for many successive years. Although this high death rate is chargeable to many maladies, the losses are largely due to seven diseases. In the order of their importance, they are: tuberculosis, contagious abortion, anthrax,¹ blackleg, scabies, ticks, and foot-and-mouth disease. Fortunately, the ravages of most of the common diseases of cattle can be largely controlled if stockmen will become familiar with the characteristics of the more common maladies and adopt proper sanitary and preventive measures.

BOVINE TUBERCULOSIS

Tuberculosis among cattle is found in every part of the United States. In fact, there is no part of the world that is known to be absolutely free from this disease. Its seriousness in the different states varies, but the total loss from tuberculosis in livestock in this country exceeds the losses from any other disease.

There is less tuberculosis among the herds in the South than in the North. Stockmen more or less generally are of the opinion that range cattle are not susceptible to the disease, but this belief is erroneous, for several range herds that have been tested have had the disease to some extent.

The financial loss caused each year by tuberculosis is enormous. Of the cattle slaughtered under Federal supervision, which is only 65 per cent of all those butchered in this country, from one-third to one-half per cent, or a total of about 40,000 head, are condemned each year because of tuberculous infections. In

¹ For discussion of anthrax in cattle, see p. 182 under "Common Diseases of Sheep and Their Control."

addition, many cattle are condemned on the farms before they reach the slaughter house.

Besides the loss in the herds, the meat and milk of a tuberculous animal endangers the lives of human beings. A considerable percentage of cases of bone and glandular tuberculosis among children in the cities can be traced directly to unpasteurized milk from tuberculous cows.

Nature and Symptoms of the Disease.—Tuberculosis in cattle is an infectious disease caused by *Bacillus tuberculosis*, of the bovine type, and is communicated from one animal to an-

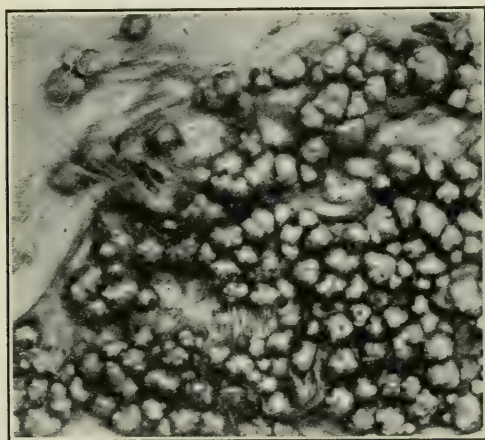


FIG. 78.—PART OF DIAPHRAGM, OR "SKIRT" FROM A TUBERCULOUS COW, SHOWING CLUSTERED TUBERCLES ON THE SURFACE.

other by the tubercle bacillus. As tuberculosis is slow in development and there is no outward indication in the early stages, it often infects a large part of the herd before the disease is discovered (Fig. 78).

"The germs from a tuberculous cow may pass from her body in the saliva, milk, or manure. The milk may swarm with germs direct from a lesion in the udder, or it may be contaminated by dust and particles of manure falling from the cow's flank. Straining does not remove anything but the larger particles, so that, unless pasteurized, milk from a herd where tuberculosis exists is very likely to cause the same disease in calves and hogs. The

saliva from a tuberculous cow keeps feed racks, mangers, and watering troughs constantly infected and the swallowing of saliva infects the bowel contents, thus spreading the disease by means of the manure."²

There are no external symptoms which can be depended upon for detecting all tuberculous animals in a herd. Some animals infected with the disease cough and others do not. The only method that will enable one to pick out tuberculous animals is the tuberculin test.

Tuberculin Test. — Many years ago the tuberculin test was perfected and it has proved remarkably accurate in the hands

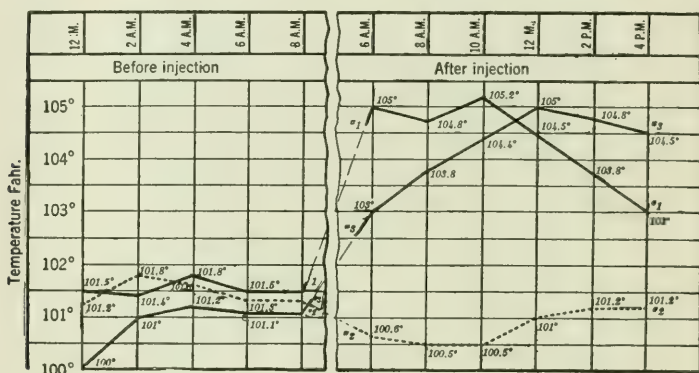


FIG. 79. — TEMPERATURE RECORD OF THREE COWS DURING SUBCUTANEOUS TUBERCULIN TEST.

In cases Nos. 1 and 3 the temperature rose sharply during the test and the cows are diseased; whereas in case No. 2 the temperature remained normal, showing that the cow was free from tuberculosis.

of the careful and experienced. No harm comes to healthy animals from its use, but only trained persons should apply the test. There are three methods of testing: the subcutaneous (under the skin); the intradermal (in the skin); and the ophthalmic (into the eye). The first two named are commonly used.

The subcutaneous test is commonly used in farm pastures. The temperature of the cow is taken until the normal range is established. A proper amount of tuberculin is then injected

² Welsh, Howard, "The Intradermal Test in Bovine Tuberculosis." Mont. Agr. Exp. Sta., Bul. 105, p. 355, 1915.

underneath the skin. If the animal is healthy there is practically no change in its temperature. If it is tuberculous there will be a rise in the temperature which will continue for several hours (Fig. 79).

The intradermal test is commonly used on the range and is accurate when done by an experienced person. A few drops of the tuberculin is injected between the layers of the skin and is usually applied in the region at the base of the tail. The reacting animals show a swelling at the point of the injection in from twenty-four to forty-eight hours after the treatment. The intradermal test is also a satisfactory one for swine.

Tuberculosis on the Range. — With a corral, a chute, and a suitable "squeeze," one man and a helper can test range cattle accurately at the rate of from 300 to 500 a day for an indefinite period when the intradermal test is used. The animals to be tested must each go through the chute twice, first for the injection of the tuberculin and again for observation of the reaction.

In working with a good "squeeze," accurate placing of the tuberculin is made easy. The animal is held motionless, the tail is raised by an assistant, and the operator is free to clean the site of injection and make the injection in a careful manner. Reacting cattle should be marked conspicuously. "Bobbing" or "bushing" the tail, that is, cutting the "brush" or tassel squarely across, is a helpful means of identification. All tubercular animals, even when grazed on the range, should at once be confined to an isolated pasture and disposed of according to the law in the particular state.

Prevention and Treatment. — Animals not properly fed are more subject to tuberculosis than the well-nourished ones. Dark, dirty, and poorly ventilated stables or sheds also help spread the germs. Healthy cattle usually acquire the disease by coming in contact with affected individuals. Watering troughs and contaminated feed may become common carriers of the germs from the diseased to the healthy animals. Calves often contract tuberculosis by drinking infected milk. Stockmen who have any reason to believe that their cattle have tuberculosis should have them tested by a qualified veterinarian.

Because tuberculosis is spread by the shipment of cattle from one place to another, there are Federal and State laws which regulate the shipping of cattle. All movement, even within a country, of diseased animals should be stopped as far as possible.

When all the individuals in a herd that are infected with tuberculosis are found and removed, the premises must be cleaned thoroughly and a reliable disinfectant applied. The manure should be drawn to plowed fields and spread to the sun. The fences, feed, and water troughs must be sprayed with a disinfectant. After this, cleanliness, with plenty of fresh air and sunshine, will keep the premises sanitary.

CONTAGIOUS ABORTION

The losses sustained from contagious abortion among cattle in this country are second only to those from tuberculosis. Europe also has many herds which are infected with this disease.

For a long time most cases of contagious abortion were confined to dairy herds, but it was not long until the disease spread to the beef herds grazed under fence and on the range where control is difficult. One reason for this is doubtless the widespread traffic in purebred animals for breeding purposes, and the fact that intensive breeding for quality sometimes seems to increase in an animal susceptibility to the disease.

American cattle owners within the past few years have lost tens of millions of dollars from contagious abortion. Huge as have been the losses in the past, they are nevertheless likely to increase unless drastic preventive measures are adopted. Besides the direct monetary loss, the death of so many purebred calves has had its effect in retarding improvement in the breeding of cattle.

Nature and Symptoms of the Disease. — Contagious abortion in cattle is caused by a germ called *Bacillus abortus*. The death and expulsion of the fetus, or developing offspring, is brought about by the entrance of this germ into the pregnant uterus, or womb, where it grows and multiplies until it causes a separation between the fetal and maternal membranes. When the attach-

ment between the fetus and the cow is broken the forming calf is left unsupplied with oxygen and consequently dies. It is then expelled, and this is called "abortion."

The death of the fetus does not always follow as a result of infection. Sometimes the constitutional resistance of the cow is so great that it prevents abortion from taking place. In this event the calf is carried the full period and is born alive, but it is usually a weakling. There is much danger under these circumstances that inflammation of the cow's uterus will be produced, and in some instances blood poisoning sets in. Sterility, either temporary or permanent, in the cow may follow the infection.

The disease develops slowly in a herd, hence the owner often assigns various reasons for the first few abortions that occur and neglects to employ sanitary measures to stop the contagion from spreading through the herd. With the exception of being premature, the signs of an approaching abortion are usually the same as those that precede normal calving. The abortion usually takes place at an early period with young animals or with those aborting for the first time. If it occurs before the fifth month, it may pass unnoticed. The discharge after abortion is characteristic, being a dirty, yellowish gray, and flaky. At times there is a bloody discharge. Unless abortion is complicated by sterility or retained after-birth, the health of the cow is little affected by an abortion and she may breed again soon and produce a living calf.

The disease appears to be spread either through the digestive tract, by means of contaminated feed and water, or by the bull at the time of service. The disease is often introduced into the herd through the presence of an infected cow. She may be an apparently healthy individual, either with calf or non-pregnant. If affected, such a cow may become a source of infection at the time she calves and remain so until the uterus is free from the disease, or until she again becomes pregnant. The milk also carries the germ and is known to cause infection in the herd.

The discharge from the genital organs of an infected cow, and

the aborted calf and its membranes contain the germs of the disease. If this material comes in contact with the feed, the disease is soon spread throughout the herd. When a bull serves a diseased cow his genitals become contaminated and he may transmit the germs to the next cow he serves. In a locality of small herds where bulls are kept for public service, contagious abortion may spread through all the herds in the community unless proper precautions are taken.

Prevention and Treatment. — No reliable cure for abortion is known. Many drugs have been tried but all have been discarded as ineffective.

To sell all aborting cows in an effort to rid the herd of the disease is poor practice. More than half of the cows affected are immune for a long time after aborting. If otherwise profitable, cows that have aborted are well worth the cost of treatment necessary to put them in good breeding condition again, for animals purchased to replace them may be infected, or are probably susceptible to infection.

Where valuable purebred cattle are raised and where there has been abortion, the cow about two weeks before calving should be placed by herself in an individual disinfected stall. An antiseptic bath may be given before the cow is placed in her new quarters. Such isolation reduces the chances of infection for the rest of the herd.

When a cow aborts, the fetus, membranes, and discharge are highly infectious and should be destroyed immediately. The case calls for skillful treatment, and a competent veterinarian should be employed. If the cow is stabled away from the rest of the herd at the time of abortion, if great care is taken to destroy and not to scatter the germs, and if everything that comes in contact with any of the discharge is disinfected, the danger to the rest of the herd is reduced. Breeding should not be attempted again within two months after abortion or until the discharge has ceased.

To prevent the bull from carrying any infection, the sheath should be irrigated with one of the antiseptics recommended for the cow. Besides this, the hair of the belly and inside of the

thighs should be sponged with an antiseptic of twice the strength of the solutions used for interior irrigation.

BLACKLEG

Blackleg, a disease which causes large losses every year among cattle, is found in nearly every country. Cattle in the North and South, on mountain pastures, and on lowlands appear to be equally subject to infection. Climate and temperature apparently have no appreciable effect on the germ.

In the United States it is the better cattle raising and feeding sections which suffer most from blackleg, although outbreaks have occurred in nearly all the states. Texas, New Mexico, Oklahoma, Kansas, Nebraska, Colorado, North Dakota, and South Dakota in the past have had the largest numbers of blackleg cases.

Nature and Symptoms of the Disease. — Blackleg is a bacterial disease (*Bacillus chauveau*) of young thrifty animals, affecting particularly individuals from six to eighteen months of age. The very young seem to be inherently immune to the disease. This immunity gradually wears off until at six months of age most of young cattle are very susceptible. Cattle more than two years old seldom contract blackleg, and some claim that an animal over three years is immune.

Usually the cattle in the highest condition of flesh and of good thrift are most commonly infected with the disease, but animals in all conditions of flesh do contract it. Lack of exercise is one of the many causes frequently given for the appearance of blackleg in a herd.

Blackleg is easily recognized. Usually the first symptom of the disease is a swelling which may appear on any part of the body except the tail or below the knees. Because the tumor is frequently on the thigh or shoulder and because when the carcass is skinned the swollen parts are observed to be dark-colored, the disease has been named "blackleg" or "black quarter." The tumors, which at first are small and painful, may appear on any part of the body. These increase rapidly in size, and in a short time may nearly cover the surface of the body. If slight pressure

is made on the tumor a characteristic crackling sound is heard, due to the collection of gas in the infected tissue.

The general symptoms of blackleg are loss of appetite, high fever, and accelerated respiration. The animal moves with difficulty and frequently lies down. If water is near, the victim will drink a little at frequent intervals. Within a few hours the animal is unable to rise. As death approaches there is a trembling of the muscles that may develop into convulsions. Death usually occurs in from twelve to thirty-six hours after the first symptoms appear. After death the carcass becomes distended with gas. Few animals survive an attack of this disease.

The largest number of blackleg outbreaks occur in the spring and the fall, but in many western states the disease appears at all seasons of the year. Blackleg appears to be spread entirely by the germs finding their way into a minute puncture in the skin where they soon multiply and spread. It is improbable that infection takes place through ingestion.

Prevention and Treatment. — Profuse bleeding and violent exercise are advocated as a cure for blackleg by some cattlemen, but as these measures are far from humane and the cases of recovery few, it is better to leave the animal undisturbed. Driving cattle suffering from blackleg over several miles only scatters the germs of the disease. When the animal is kept in one spot the germ-bearing area can be treated with disinfectant.

When blackleg occurs regularly in a pasture, feed lot, or stable, it is because the germ is either in the ground or in materials brought there. Whenever an animal dies from the disease and proper precautions are not taken afterwards, the germs in the carcass increase by the millions. These germs live for years, and although they do not develop outside of an animal they are ready to enter and continue their destructive work at any time.

As a precautionary measure, it is best to burn the carcass until the whole is consumed. Burying is unsatisfactory, as earthworms can carry the germs up to the surface. If burning is not practicable a good method of disposal is to cover the carcass with quicklime in a hole at least 6 feet deep. The top of the grave, as well as the place where the animal lay before burying, should

be thoroughly sprinkled with a 2 per cent solution of creolin, or any dip or disinfectant containing thymol or eucalyptol.

Where it is impossible to burn or bury the carcass on the spot, care should be taken to disinfect thoroughly and repeatedly every place it has touched. Even so, however, no sure way of ridding a pasture of the germ has been found.

The Bureau of Animal Industry of the U. S. Department of Agriculture has prepared a vaccine which has proved successful in combating blackleg and which may be administered by any stockman without the assistance of a veterinarian. Untold numbers of successful vaccinations against blackleg have been made by range owners and stockmen-farmers who have had only the printed directions sent with the vaccine. Outbreaks of the disease are becoming fewer because of this preventive measure which is now being widely used. The percentage of loss by blackleg now is less than one-half of one per cent of the animals vaccinated.

Outbreaks of blackleg in sheep are much less common than in cattle and the disease is less virulent.

SCABIES

Scabies in cattle, also known as mange, scab, or itch, is a disease which has prevailed in the past to a considerable extent among the range cattle of the West and Northwest, and to a lesser degree in other sections of the country. Wherever the disease is prevalent, all classes, conditions, and ages of cattle are liable to be affected by it.

Every year scab is the cause of large monetary losses to cattle owners in the United States. A herd affected with it becomes irritated, shrinks in weight, gets into an unthrifty condition, and has its growth arrested; functional disturbances commence, and there is often a heavy death rate. Western cattle that are exposed to inclement weather and are poorly nourished are particularly susceptible to scabies. In recent years, however, the losses have been greatly reduced by the adoption of control measures.

Nature and Symptoms of the Disease. — Cattle scab is a communicable disease caused by parasitic mites, of which there are four different troublesome species. To obtain food from the tissues of the animal, the mites make lesions in the skin. The location of these lesions in the early stages of the disease to some extent indicates the kind of mite infesting the animal.

The psoroptic mites live in groups on the surface of the skin and are the most common species. The first lesions made by this mite are usually on the sides of the neck and shoulders, at the base of the horns, and at the root of the tail. From these points the disease may spread to all parts of the body.

The chorioptic mites live in groups on the surface of the skin, but these groups are usually to be found on the legs or tail and do not spread much.

The sarcoptic mites burrow into the skin, each female of this form making a separate gallery in which to lay her eggs.

The demodectic mites are extremely tiny and live in the hair follicles and in the sebaceous glands of the hide. The lesions made by this species are small spherical swellings or pustules.

The Psoroptic, or Common Scab. — The psoroptic mite is visible to the naked eye and is egg-shaped, with four pairs of legs. Each female mite lays from fifteen to twenty-four eggs which hatch after three or four days of incubation. The young mites grow to maturity, mate, and the females deposit eggs in from ten to twelve days. The entire life cycle is spent on the host animal. Dipping once, if properly done, kills all the mites, but many of the eggs will survive. This new generation must be destroyed by a second dipping before sufficient time has elapsed for them to develop and deposit eggs. Ten to twelve days between dippings is the proper length interval.

The slight inflammation first caused by the mites is seldom noticed, but as their numbers increase there is intense itching and forming of papules, with inflammation and exudation of serum. This serum, mixed with dirt, hardens into scabs which are frequently stained with blood. Soon large areas are denuded of hair or wool and become covered with scabs. The animal becomes thin, weak, and emaciated, and unless relieved finally succumbs.

In the early stages the most certain diagnosis consists in examining the parasite that causes the disease. If a scraping from the outer edge of an infected area is put on a smooth black surface, warmth will cause the mites to become active and they can be seen. A low-power hand lens will disclose them on the hide.

The disease spreads more rapidly among closely confined animals than among cattle on the open range. Immunity is not developed by animals that have had one or two attacks. Contact with an infected animal will reinfect an individual, or it may become diseased from infected premises.

All sheds, barns, and enclosures should be thoroughly disinfected before clean or dipped animals are put in them. All litter and manure should be removed and plowed under so cattle will not come in contact with it. The walls, woodwork, and floors should then be sprayed with a coal-tar creosote dip or some other reliable disinfectant. In stone or wire fence corrals, if straw is strewn over the ground and then burned, the heat will destroy the mites and the eggs.

Internal remedies have not proved effective, but scab can be easily cured when taken in time, if a dip is used. The most effective dips are lime-sulphur or nicotin solution. Two dippings from ten to twelve days apart usually cure the common scab.

Chorioptic Scab. — The chorioptic scab mite, which causes what is popularly known as tail mange, common to cattle, is cured by the same treatment as is recommended for common or psoroptic scab.

Sarcoptic Scab. — Sarcoptic scab, or barn itch, as it is commonly called, seems to be increasing in the East as well as in the range country. Purebred animals which are shipped sometimes carry the disease and spread it to a new locality. It has more serious effects than common scab and is more difficult to eradicate from a herd. It may persist for years, causing irritation, arrested growth, decreased vitality, functional disorders, and increased death rate.

In a general way, the sarcoptic scab mite resembles the common scab mite. As in the latter, the entire life cycle of the mite

is spent on the body of the host animal. The sarcoptic mites, however, burrow through the skin, mate, and lay eggs in the galleries formed. The average period of incubation is about four days, and the average period after hatching until egg laying begins is about eleven days. Ordinarily, dips do not penetrate to the bottom of all the burrows, so usually more than two dippings of penetrating materials are needed. The intervals between dippings should be six to ten days.

The sarcoptic mite usually begins its work on the inner surfaces of the thighs, the underside of the neck or brisket, or the root of the tail. From here the mites may extend over the entire body.

To relieve the intense itching the animal may lick, scratch, or rub the affected parts until they are raw, causing large scabs to form. As the disease advances, the skin becomes thickened and is thrown into wrinkles. Animals with severe infections lose flesh, and unless treated a fair proportion die.

Sarcoptic scab is usually spread by direct contact with infected animals, but an entire stable that has housed mangy cattle is likely to harbor the mites and be a source of contagion. The cleaning and disinfecting for sarcoptic scab should be done in the same manner as described for the psoroptic form. The infected parts of the animal, however, should be scrubbed well with a brush and soaked with a dipping solution prior to the first dipping. Four dippings in either a lime-sulphur or nicotin dip will cure sarcoptic scab in cattle.

Demodectic Scab. — This form of scab is seldom recognized in cattle. The lesions made by these mites are different from those the three other species make, being small spherical lumps under the skin. The disease progresses slowly, but in advanced cases the lumps cover nearly the entire body. In such advanced stages of the disease the animals should be killed; in mild cases they should be segregated and dipped frequently; and the rest of the herd should be dipped at least once as a precautionary measure.

DIPPING AND SPRAYING

Either dipping or spraying is used to combat all types of cattle scab. Dipping is the most effective, for the entire body of the animal receives a wetting by this method. Much of the liquid is lost by spraying and some parts of the body may be untouched by the dip.

Dipping plants are usually arranged so that the cattle enter one end of the vat, which is filled with dip, through which they swim and leave at the opposite end.

Cattle should be watered and fed from two to four hours before dipping. If they have been driven some distance and are hot, they should be allowed to cool before dipping. When the nights are cold the dipping should be finished early enough to allow the animals to dry before night. The dip in the vat must be from 70 to 80 inches deep, so that the tallest animal which is being dipped must swim.

It is necessary to estimate beforehand the amount of dip which must be prepared for the tank in order to have it the required depth. The usual way of calculating is to multiply the average length of the tank in inches by the average width in inches, then the product by the depth in inches. Dividing the resultant figure by 231 will give the number of gallons required to fill the vat. A short-haired steer of about 1000 pounds will carry out and retain about 2 quarts of dip, and a long-haired one of the same weight will retain about 4 quarts. The total amount the animals will carry out must be added from time to time to the amount needed, to have the dip the required depth in the vat. After the vat is filled the mixture must be thoroughly stirred.

The dipping vat should be located on a site which is dry and of sufficient size to hold, besides the vat, a dripping pen and at least two other pens, one to hold the cattle prior to dipping and one to retain them after dipping until they are dry (Fig. 80).

The inside dimensions of a convenient-sized vat are as follows: length of vat at top, 26 feet, bottom, 12 feet; width at top, 3 feet, at bottom, $1\frac{1}{2}$ feet; depth, 7 feet at the foot of the incline leading to the dripping pen. Every part of the dipping paraphernalia should be examined beforehand for nails and broken

boards which might wound the animals. Cattle that are obviously affected should be held in the vat two or three minutes, and all animals should have their heads submerged at least once. Men with dipping forks, stationed along the vat, can keep the animal's body submerged during its progress through the tank

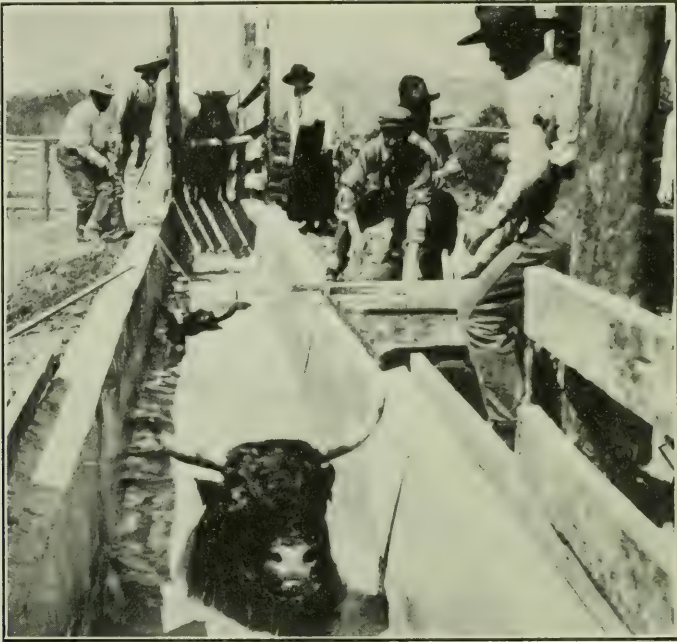


FIG. 80.—THE DIPPING VAT MUST BE DEEP ENOUGH TO MAKE THE LARGEST CATTLE SWIM.

and submerge the head in cases where it is necessary (Fig. 81). The animals on leaving the vat should be held in the draining pans until the surplus dip has run off. When the contents of the vat becomes filthy, it must be emptied, cleaned, and refilled with a fresh supply.

Any of the more common dips mix well with soft water. Hard water may be broken by using 1 to 4 pounds of sal soda to each 100 gallons of water. Lime-sulphur dip can be used satisfactorily with hard water. The nicotin dips require reasonably soft water. Both the lime-sulphur dip and the nicotin dip

should be used warm, 95 to 105 degrees being about the proper temperature. Lime-sulphur dip is made in the proportion of 12 pounds of unslaked lime and 24 pounds of flowers of sulphur to 100 gallons of water. These are mixed according to specified rules which come with the package. Nicotin dips are sold under various trade names. For cattle scab they should be diluted with water until the solution contains 0.05 per cent nicotin.

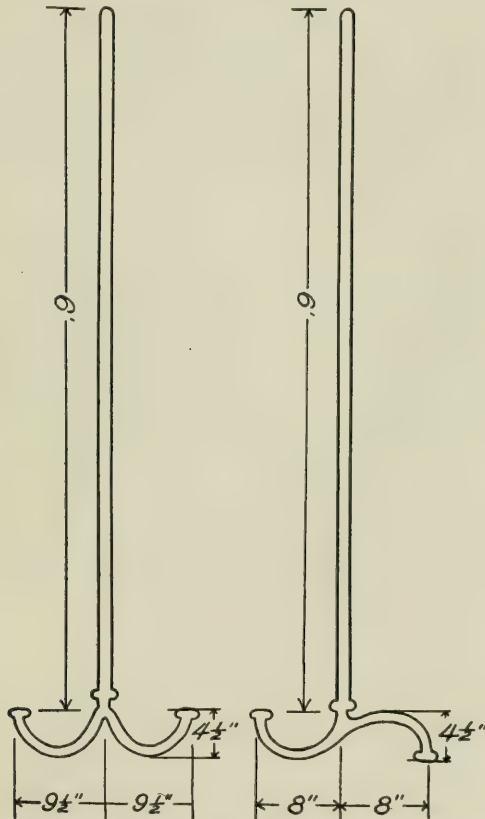


FIG. 81.—TWO STYLES OF DIPPING FORKS THAT ARE IN COMMON USE.

TICK OR TEXAS FEVER

Tick fever, or Texas fever, as it is commonly called, is believed to have been introduced into the United States at an early period by some of the cattle which the Spaniards brought with

them to Mexico and the southern part of the United States. For centuries this disease has been prevalent among the herds in many of the European countries.

In the United States, tick fever, caused by the tick called *Margaropus annulatus*, has annually caused large cattle losses in all of the southern states. In the North, until a quarantine line was established, outbreaks followed every importation of cattle from the South during the warm weather. The victims were the northern cattle that fed in the pastures where the southern animals had been.

To restrict the spread of the tick which caused the fever, the State and Federal governments in 1891 established a quarantine line beyond which, during the hot months, southern cattle could not be shipped. At the beginning of the tick-eradication campaign in 1906, this line extended across the country, from the coast of southern Virginia to the southern boundary of Texas. The southwestern part of California was also quarantined. At the end of thirteen years of eradication work, 509,084 square miles had been cleaned up and released from restriction. If the work progresses at the present rate it will not be many years before the area now quarantined will be tick free.

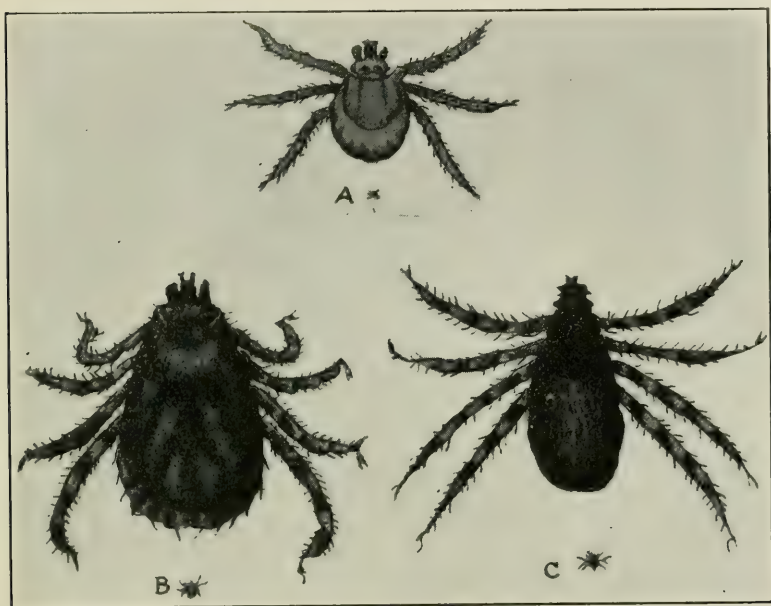
The losses of cattle from tick fever were so heavy before control measures were undertaken that difficulty is experienced in computing them. Moreover, southern cattle from an infected district sell in northern stockyards for from one-fourth to one-half cent less a pound than the quoted market price, and the tick-marked hide is unpopular on the market. The greater value of the clean cattle hides alone more than pays for the cost of the tick eradication. Then, too, the milk production of ticky cows is much below the average. The maintenance of the quarantine line costs the Federal and State governments approximately \$65,000 a year.

Northern cattle brought South are so susceptible to the disease that about 60 per cent die if not immunized by blood inoculations, and about 10 per cent die even after they are so treated.

Nature of the Disease. — Tick fever is caused by a micro-parasite that lives within the blood cells, causing them to shrivel

and crumple up. These minute parasites are carried by the tick and transmitted to other cattle through its bite. Tick fever would be unknown without the tick.

Only part of the development of the tick takes place on the host animal. The rest of its life is spent on vegetation. The tick is from one-tenth to one-half inch in length (Fig. 82). From



(Adapted from U. S. D. A.)

FIG. 82. — CATTLE TICKS.

A. Larva ($\times 25$); B. Male ($\times 15$); C. Young female.

The natural size of the tick is shown under each of the enlarged figures.

a position on brush or weeds in the pasture, to which it has climbed, the tick attaches itself to the animal's skin. Here it draws blood and increases in size.

Upon maturity the female increases rapidly in size, for she usually becomes engorged in from two to four days. When fully engorged the female drops to the ground and seeks a hiding place on the moist earth under cover, away from the sun and her numerous enemies, particularly birds. Here the egg laying soon begins. She dies when the egg laying is completed.

The period of incubation which takes place before the eggs are ready to hatch is about 19 days in summer and in cold weather approximately 200 days. A small, oval six-legged larva issues from the shell. The larva soon becomes active and ascends nearby vegetation, thus attaining a position which gives him a good chance of reaching a host animal. If he fails to attach himself to a host he dies of starvation, for a "seed" tick takes no vegetable food. He may live for eight months, however, without food. Once on an animal the tick's life cycle begins again.

Aside from carrying the fever germ, the ticks, by blood sucking, lower the vitality of an animal and cause it irritation and worry.

Symptoms. — From fifteen to ninety days after cattle are infected with the Texas fever germ they become feverish. There are two types of the fever, the acute and the chronic. With the acute form, the temperature rises in a day or two to 107 or 108 degrees. The animal, in acute pain, with dry muzzle, has lost his appetite and stands with the head lowered and back arched. Constipation, which is present at the beginning of the disease, changes later to diarrhea. The manure is stained with blood in all acute cases, but may not be in chronic ones. The color of the urine varies from light pink to almost black, depending on how rapidly the red blood cells are being destroyed. The blood is watery and pale, showing the reduction of the cellular element. Death usually occurs in from three to four days.

The symptoms of the chronic form are similar to those of the acute but much milder. Death rarely occurs, but the value of the animal is greatly reduced.

Prevention and Treatment. — There are two ways of eradicating the tick — attacking it in the pasture or treating it when on the cattle. Cattle may be kept free from the parasites either by killing the ticks on the animal with a solution, or by not pasturing until the ticks have dropped from the vegetation. The destruction of the ticks on the animals by dipping is the method commonly used.

When eradication by dipping is undertaken, all the cattle and any other animals on the farm harboring ticks must be dipped every two weeks during warm weather. Even after all

the ticks have apparently disappeared from the cattle, the dippings should be continued until it is known positively that the animals are free from ticks.

FOOT-AND-MOUTH DISEASE

More or less intermittently since 1839, enormous losses among cattle, sheep, and hogs in Europe have resulted from foot-and-mouth disease, or aphthous fever. The disease has become so firmly established in some parts of the Old World that its eradication is hardly possible. The disease is also common in South America and has been reported from Asia and Africa. Since 1870, which marks the initial outbreak in the United States, foot-and-mouth disease has appeared in this country seven times, the last outbreak, in 1924, occurring in California. The most serious outbreak in this country was in 1914 when twenty-two states were affected. The expense involved in the eradication of the disease is appalling.

Nature and Symptoms of the Disease. — Foot-and-mouth disease is caused by a pathogenic organism known as *Cytoryctes aphtharum*. This organism causes a contagious disorder of cloven-hoofed animals that affects the mouth, lips, tongue, udder, feet and legs. It characteristically forms vesicles of the mucous membrane and skin. The discharge from the mouth and feet contains the contagious virus. This germ-laden discharge is scattered along the path of infected animals and is carried from pasture to pasture by vermin, by domestic animals of all kinds, man, and birds. The milk from an infected animal may transmit the disease to man or to animals fed with it. The disease makes its appearance in about three to seven days after the animal is exposed. First the temperature rises to about 106° F. and in a couple of days the vesicles appear. Loss of appetite, exhaustion, and the formation of vesicles on the muzzle, lips, mouth, and tongue are characteristic of the early stages of infection. Soon the vesicles rupture, leaving deeply reddened, open sores. The irritation from these causes the saliva to drool from the mouth (Fig. 83). Lameness in the feet is also common, and as the vesicles break sloughing occurs. The most severe

foot infections are among sheep and hogs. Accordingly, the animals lie down much of the time, or they rest their weight on the knees. The duration of the attack varies widely with different



FIG. 83. — FOOT-AND-MOUTH DISEASE.

The irritation produced by the disease causes a characteristic drooling of saliva from the mouth.

animals. In mild outbreaks the appetite and the spirit of the animal usually become normal in from ten to twenty days. In the malignant form of the disease three months to a year are required for the animal to recover. In the benign type about 1 per cent of the animals die, whereas in malignant infections 50 per cent succumb. Other diseases sometimes mistaken for foot-and-mouth disease are foot rot and ergotism.

Prevention and Treatment. — In the United States every effort is given to the eradication of the disease. Treatment is not permitted. The extreme contagiousness and rapid spread of the disease fully justifies the wholesale destruction of infected or exposed herds. It is necessary to slaughter the infected and diseased animals and dispose of the carcasses. This can be done by burning, or by burying at least 6 feet deep and covering with air-slaked lime. After that the premises should be disinfected. Hearty coöperation of the stockmen and the State and Federal governments is necessary in an outbreak of this dreaded disease.

Destruction of Infected Deer. — During the foot-and-mouth outbreak in California in 1924 it was discovered that, on the Stanislaus National Forest, deer had taken the disease. This outbreak presented many new problems to be surmounted in the disease-control work. It was the first time, possibly in the history of any country, that a serious attempt was made to eradicate this disease among deer or other wild life.

Dead and sick deer were carefully examined and were found

to have the foot-and-mouth disease. Immediately following this an efficient organization was placed over the infected range area. During the period of succulent forage the deer were successfully destroyed by feeding them strychnine in salt. Later in the season the deer refused the poisonous salt, hence the slaughter campaign became dependent largely upon the use of fire-arms. The total number of deer slaughtered was 22,214, of which 2297 showed infection with foot-and-mouth disease at the time they were killed. It is probable that several thousand additional deer, which died in inaccessible places, were infected. Destruction of the deer over the infected range appears fully justified. Through their wide migration from one range to another, the infected deer on the range concerned might have spread the disease to neighboring states and into Mexico. In such a case the outcome of the eradication measures could not be foretold.³

"LUMPY JAW"

"Lumpy jaw," known to the veterinarian as actinomycosis, is an infectious disease of cattle which is characterized by the formation of tumors and abscesses. The specific cause of the disease is commonly known as the "ray fungus."

"Lumpy jaw" is not directly communicable from animal to animal or from animal to man. In most cases the germ gains lodgment in the mucous membrane of the mouth by means of sharp particles of food, such as cactus spines or awns of grasses. Also, when the mucous membranes in the mouth are injured by decayed teeth, the fungus finds ready lodgment.

"Lumpy jaw" develops slowly. In the early stages the swellings are small, but they slowly increase in size until they are conspicuous. If not treated surgically or medically, they eventually burst. The small external tumors may be removed by an operation, or an incision is sometimes made in the wound and a caustic preparation packed in.

³ Keane, Charles, "The Outbreak of Foot-and-Mouth Disease Among Deer in the Stanislaus National Forest." Monthly Bul. Dept. of Agr., State of California, pp. 213-226, April, 1927.

The treatment most often recommended for "lumpy jaw" is to give the animal large doses of iodide of potassium in a drench or in drinking water. One to 3 drams of this drug is given daily for from seven to fourteen days. The size of the dose varies with the size of the animal. Two drams are given an animal weighing 1000 pounds.

BLOATING

Bloating, or tympanites, is caused by the formation of gas in the paunch, which causes swelling in the left flank.

Many a "critter" has come to an untimely end because it became dissatisfied with the feed to be gathered from the closely cropped pasture, broke down the fence that surrounded a field containing a more luxuriant growth, and stuffed itself with the luscious, stolen greens. Fermentation develops in the mass of corn or clover and gas forms and fills the first stomach of the animal to its utmost capacity.

The danger to the animal from acute bloating is not that the distended stomach may rupture, for such an accident is almost unknown. The pressure of the gas-distended stomach exerts a dangerous pressure upon the heart and lungs, causing strangulation through inability to breathe.

Stockmen should guard against the bloating of cattle by every precaution at their command. Clover, alfalfa, or other green vegetation, if eaten when wet by dew or rain, is likely to ferment before leaving the first stomach of the animal that has fed upon it. Eating excessive amounts of middlings or corn meal will also cause bloating. The principal trouble is overeating.

To prevent bloating, cattle should be shifted by moderate stages from dry or scanty feed to abundant and luxuriantly growing fodder. They may be allowed to feed from the good forage for only three-quarters of an hour on the first day they are given access to such grazing. After that the time may be lengthened gradually.

A severe case of bloat must be treated quickly. If a veterinarian is within reach he should be summoned at once. Many stockmen, however, keep a trocar and canula constantly on

hand and thoroughly understand its use. The trocar is a sharp-pointed instrument similar to a straightened oil-can spout, provided with a metallic sheath, or canula, which leaves the point of the trocar exposed. The spot to be selected for inserting the trocar *is a point equally distant from the last rib, the hip bone, and the lateral bony projections from the spine in the region of the loin on the left side.* Here a cut about three-fourths of an inch long should be made through the skin with a small knife. The trocar, with canula attached, is pushed through the cut into the paunch. The trocar is then removed, allowing the gas to escape through the canula. The canula should be firmly tied in place and left there so long as any gas escapes through it, sometimes several hours.

If the bloating is not overly severe, it is best to resort to internal medicine to allay the formation of gas. Two ounces of aromatic spirits of ammonia in 2 quarts of cold water should be given every half hour; or half an ounce of chloride of lime dissolved in a pint of tepid water may be given every half hour until the pressure of the bloating has been removed. A dose of purgative medicine, such as Glauber's salts, will usually prove effective.

Healy and Nutter⁴ found that relatively severe cases of bloat may be corrected by the administration of formaldehyde. Relief is usually obtained in fifteen or twenty minutes by administering 1 quart of a 1½ per cent solution of formalin, followed by placing a wooden block in the animal's mouth. After the medicine has been administered the animal should be gently exercised. Formalin is a trade name for a 40 per cent solution of formaldehyde gas in water and may be procured at any drug store for about 50 cents a pint. A half ounce of formalin in 1 quart of water makes a solution of the proper strength with which to drench an animal. In the numerous tests made, no bad effects followed this treatment.

Care should be used in the administration of fluid medicines. Take time. Do not hold the cow's head too high. Keeping the

⁴ Healy, D. J., and Nutter, J. W., "A Remedy for Clover Bloat." Kentucky Agr. Exp. Sta. Cir. 5 : 10-12, 1915.

animal's head raised so that her nose is slightly higher than the level of her face will allow her to swallow without interference.

CATTLE LICE

When cattle have lice to any extent they are subject to irritation, digestive disturbances, arrested growth, and low vitality, and an increased death rate results. The greatest losses from lice occur in young animals and in old stock that are poorly nourished.

There are three different types of cattle lice, but all are injurious to cattle (Fig. 84). The long-nosed and the short-nosed

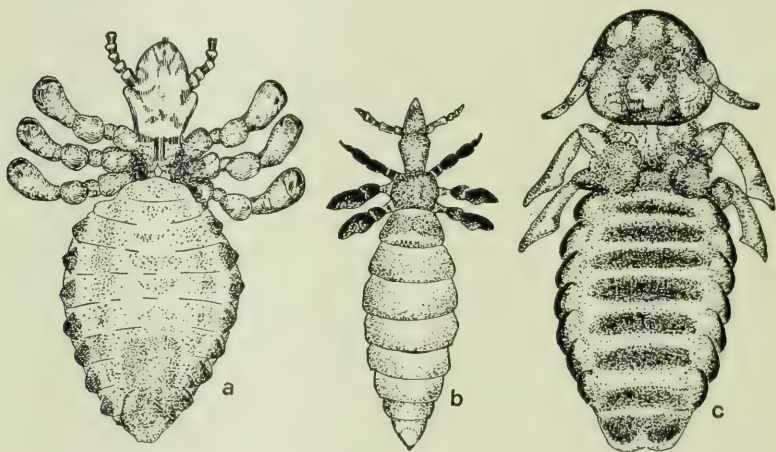


FIG. 84. — CATTLE LICE.

a. Short-nosed louse; b. long-nosed louse; c. "little red louse." Much enlarged.

lice belong to the "bloodsucker" or suctorial class, and are commonly called "blue lice." The third species is a biting louse and is known as the "little red louse." The short-nosed louse is usually found on mature cattle, whereas the long-nosed prefers calves and young stock for its host, but may be found on older animals. Lice pass their entire life on an animal. Biting lice are found on all ages of cattle. They are smaller than the sucking lice, but are visible to the naked eye. Cattle lice are to be

found in the largest numbers during the winter when the hair on the animal is long.

There are three ways of eradication: hand applications of poisonous powder, spraying, and dipping. The last is preferable. Before any eradication measures are taken, however, the premises and stables should be cleaned and disinfected. The short-nosed louse is harder to eradicate than the long-nosed and the biting species. One treatment with arsenical dip or coal-tar creosote usually eradicates the latter, but the short-nosed variety will require at least two treatments and sometimes more. The treatments should be sixteen days apart. The dipping directions for lice are the same as for ticks.

DISEASES OF STOMACH AND BOWELS

Depraved Appetite. — Cattle that have this disease possess little appetite for ordinary food, but are constantly licking and eating substances for which healthy cattle show no inclination. Lime, earth, coal, gravel, and even the dung of other cattle are some of the substances consumed by cattle with a depraved appetite. The individuals most prone to develop this disease are pregnant cows and young cattle.

Cattle with depraved appetites lose condition, their gait becomes slow, and small vesicles containing yellow fluid form under the tongue. The victim is restless, and after many months, emaciated and exhausted, it dies.

It is commonly believed that soil, water, and local vegetation are responsible for this disorder. Cattle pastured on low, swampy land are most apt to contract the disease.

To improve digestion and to supply the animal with proper food is the aim of any treatment for this condition. The following prescription is recommended as excellent for this purpose: Carbonate of iron, 4 ounces; finely ground bone, 1 pound; powdered gentian, 4 ounces; common salt, 8 ounces; powdered fenugreek, 4 ounces. Mix thoroughly. A heaping teaspoonful of the mixture should be given the cow three times a day. It is also helpful to mix 3 tablespoonfuls of powdered charcoal with

the food three times a day and have a goodly supply of salt available to the animal.

Diarrhea and Dysentery. — Diarrhea is caused by chilling, exposure, improper feeding, irritant foods, indigestion, organic diseases of the intestines, and parasites.

A pint of castor or linseed oil is helpful when the trouble is caused by food with irritating properties. Useful household remedies are raw eggs, strong coffee, parched rye flour, or a decoction of oak bark. Carefully selected food should be given sparingly, and, if possible, the animal should have complete rest.

Indigestion from Drinking Cold Water (Colic). — This disorder is produced by too rapid drinking of cold water which produces cramps in the fourth stomach and in the bowels. An ox, after hard work in hot weather, and cattle fed largely on dry hay, may drink too large quantities of water at one time and become affected with colic. There is distention of the abdomen.

The colicky animal should be walked about for ten minutes. This often gives relief without medicine, but where the cramps and pains persist, the following may be given: 1 ounce of sulphuric ether, 1 ounce of tincture of opium, and 1 pint of warm water, shaken together. If the animal is not relieved, repeat the dose in half an hour.

Gastro-enteritis. — The symptoms of gastro-enteritis are dullness, drooping ears, dry muzzle, staring coat, and loins very sensitive to pressure. The left flank is full, owing to the distention of the fourth stomach. The animal walks as if in pain and there is loss of appetite and absence of rumination. Constipation is present in the early stages, followed later by severe diarrhea, accompanied with colicky pains and fever. The disease is always severe and often fatal.

Give small quantities of carefully selected food and protect the animal from cold and dampness. Tannopin in doses of 30 to 60 grains is recommended, or subnitrate of bismuth in doses of 1 to 2 drams may be given. The medicine should be put in linseed tea, boiled milk, rice water, or oatmeal gruel. If the diarrhea is serious, give 1- to 2-dram doses of opium.

QUESTIONS

1. To what extent do diseases enter into economic beef production?
2. Name the seven diseases that cause most of the losses in cattle.
3. (a) In what parts of the United States does tuberculosis occur? (b) What per cent of tuberculous cattle die from the disease? (c) How many tuberculous cattle were condemned on the average between 1910 and 1920 by Federal meat inspectors? (d) Describe the nature and symptoms of tuberculosis in cattle. (e) Describe the reaction of a tuberculous cow when given the subcutaneous test.
4. (a) How do losses from contagious abortion compare with those from tuberculosis? (b) Discuss the causes, nature, and spread of contagious abortion. (c) How should cases of abortion be treated and how may its spreading through the herd be controlled?
5. (a) What domestic foraging animals are free from infection by anthrax? (b) Discuss the life cycle of the germ that causes anthrax in cattle. (c) Describe the forms of anthrax and point out the characteristic symptoms of each. (d) Discuss the spread, treatment, and control of anthrax in cattle. (See Chapter XI.)
6. (a) To what extent are losses in cattle caused by blackleg? (b) In what parts of the United States does blackleg cause the heavy losses in cattle? (c) Discuss the relation of age of cattle to susceptibility to blackleg. (d) How may blackleg be recognized? (e) What are the general symptoms of the blackleg disease? (f) Discuss fully methods of preventing blackleg infection in the herd. (g) Are losses among sheep serious because of the blackleg disease?
7. (a) Discuss the nature of scabies and describe the parasitic mites that cause the disease. (b) What are the characteristic symptoms of, and the treatment for, psoroptic or common scab? (c) How would you recognize sarcoptic scab? (d) How would you handle the cattle and prepare the dip for the treatment of scab?
8. (a) To what extent do cattle suffer from tick fever or Texas fever tick? (b) What is the nature of tick fever? (c) Describe the life history of the Texas fever tick. (d) Discuss methods of prevention and control of the Texas fever tick.
9. (a) What are the symptoms of foot-and-mouth disease? (b) Are infections common in the United States? In Europe? (c) What animals are affected? (d) Discuss measures for eradicating this disease.
10. (a) What is the cause of "lumpy jaw"? (b) How would you treat this disease?
11. (a) Under what conditions does bloat in cattle most commonly occur? (b) Explain the use of the trocar and state at what point it is inserted into the animal.

12. Discuss the treatment for cattle lice.
13. What treatment would you resort to if a calf had a bad case of (a) diarrhea? (b) gastro-enteritis?

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PART FOUR

ECONOMICS OF PASTURE LIVESTOCK

CHAPTER XIX

COST ACCOUNTING AND BUDGETING IN LIVE-STOCK PRODUCTION

A business planned for operation over an indefinite period, with full cognizance of the fluctuations in prices and production costs, may be classed as an investment. To determine whether

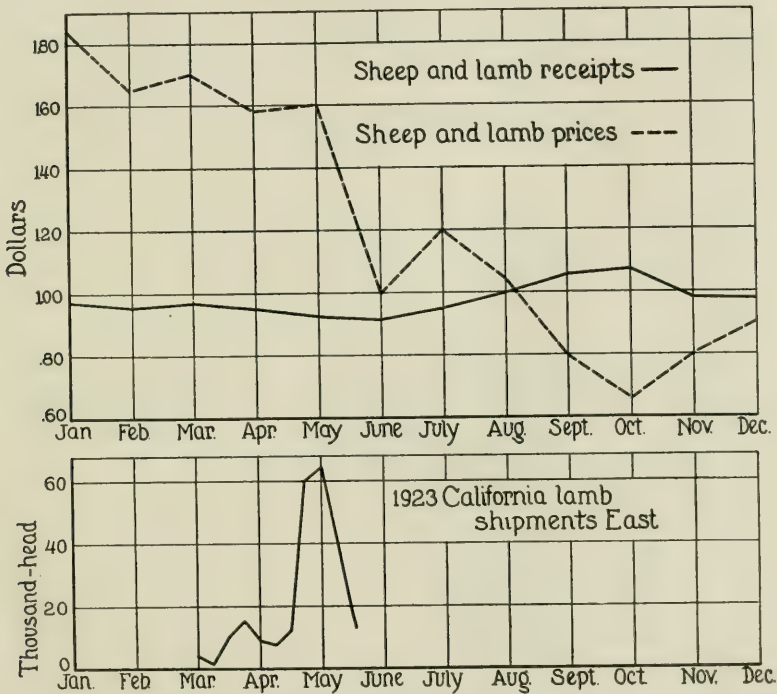
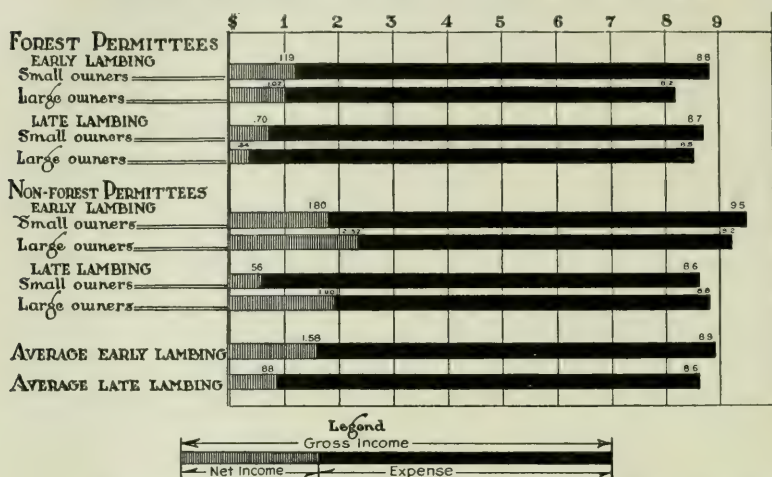


FIG. 85. — RECEIPTS AND PRICES OF SHEEP AND LAMBS IN RELATION TO EARLY LAMB PRODUCTION IN CALIFORNIA.

a venture is an investment or a speculation, it is necessary to make a systematized study of the annual costs and the net returns, and to ascertain whether it is possible so to budget the expenditures that they will not exceed the income. Such data also make

possible direct comparisons of the different cost items, thereby pointing a way to more efficient management through decreased

GROSS AND NET INCOME IN DOLLARS PER HEAD



DETAILED DIVISION OF THE AVERAGE EXPENSE OF EARLY AND LATE LAMBING AS SHOWN BY THE ABOVE GRAPH

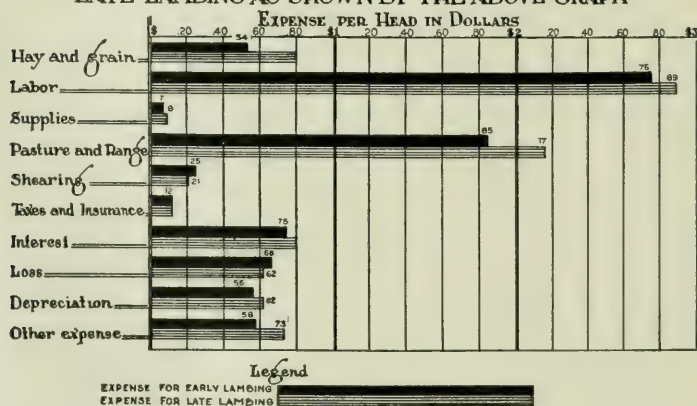


FIG. 86. — COMPARATIVE INCOME FROM EARLY AND LATE LAMBING IN CALIFORNIA.

costs and by improved marketing. Likewise, in a new locality cost and budget figures will indicate the wisdom of expansion.

In some localities specialized livestock production and specific seasons for marketing the product justify expansion (Figs. 85

and 86). The wisdom of such expansion may be judged by analyzing the items of expense and of profits, as has been done in certain western states (Fig. 87).

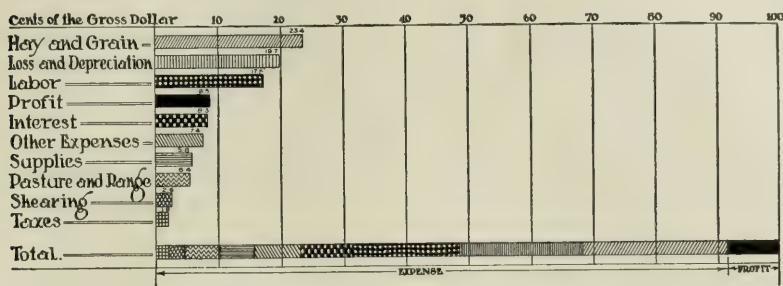


FIG. 87. — DIVISION OF THE GROSS DOLLAR IN IDAHO SHEEP PRODUCTION FOR 1924.

COST ACCOUNTING

Regardless of the kind of livestock raised, the producer should choose a twelve-month period for each book-record summary and inventory. Many prefer January 1 as the year's closing record date, because it corresponds with the income tax reports. Others prefer to close their book records after the date of the last beef round-up, or the last sale of the year of lambs and wool. It is important that a definite and regular closing date be adopted.

Accuracy of Inventory Values Essential. — Although exact income and expense figures can be obtained each year, the matter of profit or loss for any one year must be considered relative. This is because such statements embrace inventory values, which, at best, involve a variable factor. Indeed, by recording high enough inventory values at the end of each year, it is possible in an established business never to show a loss. High inventories, showing, as they do, only paper profits, have no value with loan organizations or with creditors. Obviously, the usefulness of a stockman's inventory depends entirely upon the correctness of his appraisals. False values are worse than useless — they are actually dangerous, and may prove disastrous to the individual concerned.

The safest livestock inventory is procured by taking average

evaluation prices and disregarding wide departures in the current market. Obviously, the age classes and the breeding of the animals must be taken into account, but usually the annual sales and the replacement of livestock will have values much the same, year for year. Also, unless imposing improvements have been developed during the year, the most reliable profit and loss figures will generally be procured by adopting the principle that the physical equipment is the same at the end of the year as it was when the inventory was taken a year earlier. Such an inventory plan assumes that the maintenance costs will counterbalance those of depreciation.

Segregation of Cost Items. — Many stockmen neglect to keep efficient accounts of their enterprise because they feel that book records are complicated and impracticable. This is far from the truth, provided a system is adopted which permits of listing costs as they occur, under broad, clearly defined headings.

The most practical, hence scientific, cost-keeping system of a range livestock enterprise that has come to the author's attention, is that adopted and used for more than twenty-five years by a successful cattle raiser, Mr. H. T. Liliencrantz, of Hollister, California. The plan is summarized here because of its apparent broad application to ranch operations generally, regardless of the kind of livestock grown. The writer is indebted to Mr. Liliencrantz not only for information as to his cost-keeping plan in general, but for his constructive suggestions in the reading of this chapter.

According to the plan here proposed, every item of expense in the operation of a livestock ranch can be listed under the following headings: (1) the feed account, including rent of pasture or land for growing crops for the livestock; (2) interest on cattle and sundry equipment; (3) labor; (4) general or miscellaneous expense; and (5) taxes.

A list of some of the more ordinary items that are charged under the five headings should prove helpful.

Feed Account. — In this account are included rental charges of all lands owned by the stockman and used for cattle production; all regularly leased pasture and hay land used in the

rearing of the animals; extra pasture leased for a single season of poor forage growth, or used for stock watering purposes; and all farm land whose crops are used directly or indirectly for cattle production. Charges are also made for all supplemental feeds purchased, such as hay, cottonseed cake, grain, and beet tops.

Briefly, all actual rental charges and all appraised rental values of land owned and used in raising cattle are charged to the cattle business, as well as the cost of feeds purchased. It should be understood that land ownership and the rearing of livestock are handled as strictly separate concerns. This is justified because a man who owns range pasture land, or farm land used in livestock production, is not necessarily a livestock owner, but can, as frequently happens, lease his land to a livestock grower. Moreover, many livestock men do not own an acre of land, but rent all the pasture and tillable lands needed for the breeding and growing of their livestock.

On the other hand, taxes and money spent in the erection of new buildings and fences, the development of water, and other such improvements, *should be charged to the land*, or to the land owner, and *not to the livestock*, since the animals are charged with land rentals.

Interest on Livestock and Sundry Equipment. — The annual charges of interest are made at prevailing rates, and embrace essentially the following items: (1) Interest on the cattle, based on a conservative inventory value, provided an inventory is taken each year — otherwise it may be made on the investment value. This item would include loans for which the cattle are given as security. Thus if a stockman owned cattle valued at \$25,000 and had borrowed \$10,000, the cattle would be charged with the interest on \$10,000, as paid to the bank, and the interest on \$15,000, credited to the account of the owner. (2) Interest on a conservative inventory of sundry equipment, such as horses and farm implements, used in the enterprise, the amount being credited to the owner. (3) Amounts paid the bank for money borrowed for meeting current operating expenses. (4) Charges made by the bank or loan company for expenses

incidental to securing loans, such as fees for inspection, expenses of drawing up papers, and similar charges.

Labor. — This heading embraces, in most cases, only the cost of all classes of labor used in the operation of the livestock ranch, and the cost of board for the men.

The small operator will usually hire a man at an agreed monthly wage, including board. A large operator will likewise hire men at a stipulated monthly wage, including board, and will usually arrange to pay the married foreman an agreed amount by the day for boarding the extra help. In either case the cost of the meals is charged to the labor item.

In some instances a charge is made against labor for the salary of the ranch owner, who is also the ranch manager. Opinions differ as to the wisdom of such a charge, but except on very large ranches it does not appear justified. On most livestock ranches the income of the owner consists of the interest on the investment he has in the enterprise (charged to his animals or land and credited back to him), in addition to yearly profits, such as there may be. Theoretically, he could credit himself with a salary; but to do so would necessitate his charging against himself innumerable items which his ranch would furnish him and his family. Such detailed charges would greatly complicate the bookkeeping. In the consideration of the salary charge, Mr. Liliencrantz presents a viewpoint which is of general interest:

“This question of salary for the owner and operator of a ranch is one which emphasizes the main points of difference between country and city life. The rancher’s place of business is also his home; the city man’s business and his home are generally distinct and apart and require segregated investment and operating expense. If a man with \$25,000 goes into the cattle business, he buys a ranch and expects to live on it. What is the home feature worth? If a city man has \$25,000 to invest in business, he needs also \$10,000 (or he must pay interest in form of rent) for a home. The home and his business have nothing in common, whereas the affairs of the rancher’s home and his business are inextricably interwoven.”

General Expense. — Expenses of all sundry equipment are

charged under general expense. Typical items of purchase would be wagons, mowers, work stock, seed grain, horseshoes, vaccine, brand-inspection fees, cost and operation of automobile, and extras and repairs of all kinds. As pointed out, however, personal or family expenses are not included except in special cases.

If an automobile is used exclusively in the interest of the live-stock business, the entire cost of the machine and of its operation are charged to general expense. But if the use of the machine is divided between the livestock operation and personal or family services, then both purchase and operating costs are equitably prorated. A personal account, as well as a business account, therefore, should be kept.

Small sales of various items other than the major kind of live-stock reared, such as a few goats, a horse, a few hides or pelts, and used farm implements, are merely credited to general expense.

Taxes.— Under taxes are charged the assessments on the major kind of livestock produced; on work stock, and on other kinds of livestock grown for profit, such as a few goats or hogs; and on sundry equipment, such as farm implements, used in the interest of the livestock.

All taxes on land owned and on permanent improvements, as previously shown, are charged with land rentals, hence are not included under the heading of taxes.

Summary of Operating Costs and Sales Records.— The following summaries, which are actual cases, illustrate the extent to which the essential detailed costs of the breeding herd are made available through the book records here outlined:

OPERATING COSTS OF THE BREEDING HERD

Year	Total operating expense	Number of cattle	Feed per head	Interest per head	Labor per head	Expense per head	Taxes per head	Aver- age cost per head
1924.....	\$13,508.76	846	\$9.45	\$2.83	\$2.19	\$1.08	\$.40	\$15.95
1925.....	13,676.80	820	9.75	2.92	2.36	1.24	.40	16.67
1926.....	13,534.04	818	9.78	2.93	2.21	1.22	.40	16.54

The total operating expense for the year and the number of animals owned are at once available. The expense may be shown on a per animal basis under the five headings: namely, feed, interest, labor, expense, and taxes. From these figures the yearly cost per animal is readily procured.

Another factor of importance is that of keeping an accurate record of all sales made. The desired detailed records are likewise illustrated in the following table from actual range records:

SALES RECORDS OF BEEF CATTLE

Year	Number cattle sold	Total weight, pounds	Total value	Average weight, pounds	Average value per head	Average value per pound	Cost per pound
1924.....	211	236,086	\$14,631.23	1118	\$69.34	\$.0619	\$.0572
1925.....	205	240,379	16,052.86	1124	78.30	.0667	.0569
1926.....	230	250,065	16,223.59	1087	70.50	.0648	.0541

Livestock Replacement. — The outstanding advantage of the cost record plan as here outlined is that of simplicity. No minor accounts, such as cost charges against saddle stock, automobile, maintenance of corrals, or other equipment are kept, nor have such detailed items been found essential in actual practice. Moreover, the cost accounts are not complicated by herd-replacement figures. On any rationally operated livestock ranch, which is a going well-managed concern, the herd or band replenishes itself automatically. For this reason it is not necessary to charge the cost of livestock production with depreciation of the breeding animals. And, as indicated, this same reasoning applies to the maintenance of general equipment, such as fences and corrals. Maintenance of the physical plant is effected each year by the purchase of new materials to repair or replace the old. Record of such purchases is properly kept under the heading of general expense.

Details of the Bookkeeping. — Although the double-entry system is most desirable, keeping in mind the cardinal principle

that "every debit must have its credit," the single entry will serve in general. The chief difficulty with most stockmen is that they use no system at all. They do not know what kind of books to buy, hence none are provided. This fact accounts for the records being jotted down on calendars, diaries, and detached sheets of paper, which may be lost.

Concerning the kinds of books used and the general system followed, Mr. Liliencrantz has the following to say:

"I use the loose leaf system for Cashbook, Journal, and Ledger, keeping a large bound book for record of cattle purchases and for sales. From the sales books I can trace any transaction in cattle since 1897. I have two extra loose leaf binders for the used sheets. For my bank account I never use the stub books as furnished by the bank but enter every check drawn on a page of Journal type and post into Ledger from that. This gives a correct and permanent record. A Ledger entry will show either Journal page, Cash book page, or check number. My check record will show check number, date, whether or not posted in the ledger, and whether or not received back from the bank as a voucher. I can trace anything back for the last 4000 checks drawn. I tie the vouchers in bundles of 500 and keep 2000 back ones."

Forms to Use. — The following forms provide a simple means of keeping accurate accounts wherein the financial condition of the individual or company is readily available.

The Journal (Fig. 88) is used for making all entries. From this form the monthly total of each classification can be posted to its proper place in the Ledger. For convenience the Ledger should be divided into three sections: Assets, Liabilities, and Operating Expenses. Amounts affecting the general ledger accounts are entered in the General column, while charges or credits to the various other accounts are entered in their respective columns. Operating expenses would be entered in the column headed Expense. The distribution of the expense should be noted in the item space under one of the headings shown on the form in Fig. 89. This form is posted once each month, probably on the first day of the month. Where more than one ranch is operated it is advisable to keep separate expense accounts.

The form shown in Fig. 90, is a regular Ledger sheet. There should be one of these for each creditor, one for each debtor, and one for each asset that is important enough to be considered separately. There should also be a separate sheet for the personal account of the operator and one for the bank account.

HOME RANCH 1928											
DATE	ITEM	INTEREST	TAXES	FEED	LABOR	MISC. EX.	TOTAL	NO. OF CATTLE	AVER. COST PER HEAD		
	JANUARY			9.00							
	FEBRUARY										
	MARCH										
	APRIL										
	MAY										
	JUNE										
	JULY										
	AUGUST										
	SEPTEMBER										
	OCTOBER										
	NOVEMBER										
	DECEMBER										
	YEARLY TOTALS										

FIG. 88. — FORM FOR JOURNAL.

In dividing the Ledger into three classifications it is not necessary to have three separate books, for all of these sheets can be obtained in the same size and placed in a different part of the Ledger, divided by heavy paste-board sheets, and all enclosed within one loose-leaf binder.

The Journal should be the first section as it furnishes a detailed record of the various transactions and is valuable as a record, although it does not disclose the financial condition of the business. The general accounts should contain all the assets of the livestock enterprise and should consist of the accounts for each of the following items: main class of livestock (cattle or sheep); bank account; the various debtors, if any; miscellaneous livestock, such as hogs and goats; work animals; and equip-

BUDGETING

A budget is merely a stock-taking of the necessary financing for the year's operation. It aims to balance, as it were, the costs or expense items against the income.

In order to prepare a budget of value, a good cost-keeping record is essential. The budget may be prepared as soon as the balance sheet and statement of the previous year are completed, for then the resources of the ranch are known, hence plans for operation of the ensuing year may be made. Although it is not possible to plan the details of management several months in advance, or to predict exact income from sales, it is nevertheless helpful to prepare a budget that will express one's hopes and plans. With plans well worked out, the operator has a valuable check each month on the trend of his business. He knows, from the way the grazing capacity of the different pastures is holding up, the amount of autumn and winter feeds he will have; the amount of concentrates and roughages that can be sold; the number of animals that can be marketed in prime condition; the approximate time of their disposal; and the prices that may be expected.

In the following outline, Potter¹ has suggested budget items for consideration in a range sheep operation. These items, with suitable adaptations to local conditions and kind of livestock raised, will not only indicate the financial possibilities but the weaknesses of the business as well.

¹ Potter, E. L., "Budgets for Sheepmen." *The Natl. Wool Grower*, Vol. 27, No. 11, pp. 29-30, Nov., 1927.

Budget for Year Ending.....

Name.....

Address.....

EXPENSES

Labor:

Herders	\$.....
Tenders	\$.....
Lambing	\$.....
Ranch Labor	\$.....
Shearing and Marketing Wool	\$.....
Total Labor	\$.....
Forest Reserve Fees	\$.....
Leases	\$.....
Feed Purchased	\$.....
Bucks	\$.....
Taxes	\$.....
Interest	\$.....
Upkeep of Outfit	\$.....
Miscellaneous.	\$.....
Total Sheep and Ranch Expenses	\$.....
Personal Expenses	\$.....
Total All Expenses	\$.....

INCOME

Lambs:

.....Head @ \$.....	\$.....
.....Head @ \$.....	\$.....
.....Head @ \$.....	\$.....
.....Head @ \$.....	\$.....

Ewes:

.....Head @ \$.....	\$.....
.....Head @ \$.....	\$.....
.....Head @ \$.....	\$.....

Bucks:

.....Head @ \$.....	\$.....
.....Head @ \$.....	\$.....
.....Head @ \$.....	\$.....

Wool:

.....Pounds @ \$.....	\$.....
-----------------------	---------

Miscellaneous Income \$.....

Total Income \$.....

Less for expenses (as above) \$.....

Cash Balance \$.....

Deduction for depreciation (if any) \$.....

Net Gain \$.....

A budget for a cattle ranch would take into account such major items as the following:

Estimated Cost of Husbandry:

Labor:

Breeding Cows \$.....

Bulls

Calves, Yearlings, Young Heifers, and Young Steers

Beef to be Marketed

Veterinary Services

Interest on Investment in Cattle

Feed:

Pasture (Grazing Fees and Rentals)

Supplemental Feeds

Taxes:

Assessments on Cattle \$.....

Assessments on Work and Other Livestock

Assessments on All Sundry Equipment

Estimated General Expense and Sundry Equipment:

Saddle and Pack Animals \$.....

Work Horses

Machinery and Harnesses

Seed

All Sundry Expenses

QUESTIONS

1. How may reliable cost records of the raising of livestock be used to point out ways of decreasing the cost of production?
2. (a) How should inventory values be procured? (b) What is the real value of an inventory?
3. According to the plan proposed in this chapter, what are the major headings under which the various expenditures are grouped?
4. (a) What items are included in the summary figures of operating costs of the breeding herd or band? (b) What items are included under the summary of the "sales record"?
5. Discuss the details of bookkeeping with respect to the forms to be used.
6. (a) How would you proceed to prepare a budget for a livestock ranch? (b) What is the chief value of such a budget?

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CHAPTER XX

ANIMALS THAT PREY UPON LIVESTOCK AND RODENTS THAT DESTROY FORAGE CROPS

The most exasperating problem with which the stockman must contend is that of overcoming the financial losses caused by animals of prey and forage-destroying rodents. The spectacular maiming and killing of all classes of livestock by their prowling enemies arouses in the ranchman the determination to cope with the evil. That there is justification for the feeling of resentment is apparent from the fact that the value of livestock thus slaughtered yearly is estimated at from \$20,000,000 to \$30,000,000.¹ If one includes with these figures the ravages caused by vagrant dogs among sheep and goats on farms, and the consumption and destruction of forage crops by rodents, the annual financial loss is appalling. Fortunately, by continuous systematic effort, the operations of these enemies can be curbed appreciably.

PREDATORY ANIMALS

From the Great Plains region westward to the coast — the natural livestock breeding grounds of the nation — wild carnivorous animals are found in the largest numbers. This region, once heavily grazed by buffalo, elk, deer, antelope, and mountain sheep, is the native habitat of the coyote, bear, wolf, wildcat, and mountain lion. Originally these predaceous beasts feasted largely on the wild game, but because of the decrease in the numbers of game animals, they now prey extensively upon domestic livestock.

Wide variation exists in the numbers of the different predatory animals in different localities, and in the destructiveness of the various kinds and individuals. Considering the West as a whole,

¹ Bell, W. B., "Hunting Down Stock Killers." Yearbook, U. S. Dept. Agr., pp. 289-300, 1920.

however, the coyote is unquestionably the most destructive. Following the coyote, the order of destructiveness is — mountain lion, wolf, wildcat, and bear. The destruction by these animals for the period of their existence, as estimated in terms of the value of livestock injured and killed, is, for each coyote, bobcat, and lynx during its period, \$50; for each wolf and mountain lion, \$1000; and for each stock-killing bear, \$500. In the middle western, southern, and eastern states the vagrant dog is responsible for nearly all livestock losses caused by carnivores.

COYOTE (*Canis* spp.)

The settling of a country results in a marked decrease of almost all wild animal life, but the “ diplomat of the range ” — as the coyote is called — is an exception. His cunning and speed have enabled him to retain his sovereignty over much of his territory, despite organized efforts to exterminate him.

“ Coyote ” is the Spanish name for the small prairie wolf found in the western and southwestern parts of North America. The name is well chosen, as it serves to distinguish the coyote, which is a true small prairie wolf, from the large gray or dusky wolf that inhabits the same region. The coyote is the most widely distributed of our predatory animals, being found from the central Mississippi Valley to the Pacific Coast, and from Costa Rica on the south to the prairies of Athabasca on the north. Except in their extreme northern habitat, coyotes are numerous over most of their range. Some fifteen species have been recognized. The food and life habits of the different species are generally similar.

Coyotes are lean, wiry, fleet-footed, and light, and weigh 25 pounds or more (Fig. 91). They inhabit all elevations, in summer sometimes living above timberline. In winter they drift to the foothills and valleys in search of food. The presence of coyotes is recognized at once by their characteristic prolonged, syncopated howling, heard usually only at night.

Coyotes generally breed once a year, but sometimes two litters are raised. The mating season, which varies according to the

zone they inhabit, begins in January and sometimes extends into May. They are strictly monogamous, are constantly together, and hunt food jointly for the pups. The period of gestation is about sixty-three days, the same as that for the dog. The pups, usually five to seven in each litter, are born in dens, among rocks, or in wash-outs along banks of streams.

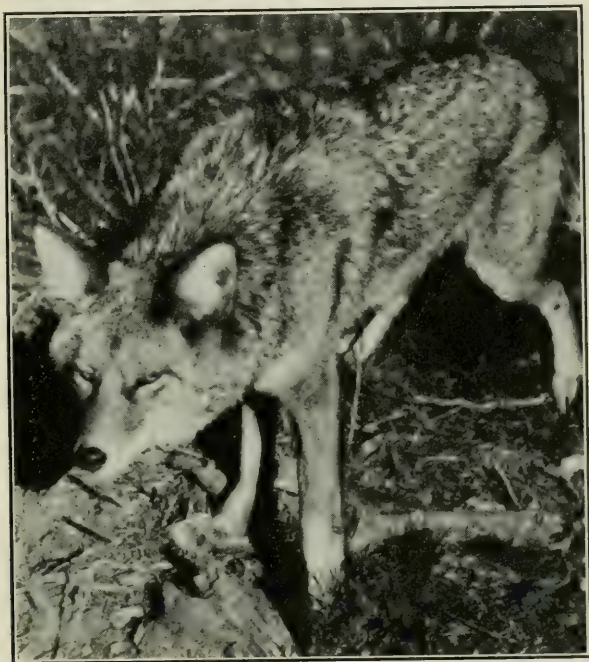


FIG. 91. — THE COYOTE — THE RANGE DIPLOMAT.

Their food consists largely of animal matter, but they will occasionally eat ripe cultivated fruits such as plums, prunes, or peaches, and various native berries. Their appetite for meat ranges from large game and young domestic animals to rodents of wide variety. They also eat birds, fish, and even reptiles.

“I’ve about concluded that the coyote is the best friend the cattleman has on the range. Kill out this howling little cuss and the ground squirrels, prairie dogs, and rabbits will leave practically no feed for the cattle.”

That is the statement of an experienced cattle grower in Nevada. But in the same community a prominent sheep grower said: "Coyotes are a much greater source of loss than are blizzards and droughts. Adverse weather conditions usually come at expected intervals and we prepare for them; but coyotes are crawling about on the outskirts of a band of sheep during every month in the season, day or night, awaiting an opportunity to sink their teeth into the throat of a choice lamb or sheep. Large bunches of sheep that stray from the band are killed in a night, as the coyote will kill just for sport."

In Utah three coyotes killed \$500 worth of sheep in one hour. In Colorado, sixty-seven ewes that had strayed from the band were killed in two nights. In Utah, fifteen purebred rams were killed in two nights by four coyotes.²

True, the food of coyotes includes many forage-destroying rodents, hence coyotes are beneficial to the pasture and farming interests. Rabbits, prairie dogs, ground squirrels, gophers, field mice, and chipmunks are staple articles of the coyote diet. Coyotes are useful also as scavengers on the range, for they feast upon carcasses of all livestock, leaving only the bones. Organized warfare against the coyote has doubtless resulted in appreciably increasing the rodent population in some localities. However, this disturbance in the balance of nature, as it has been termed, favoring the rodents, is not very serious, as effective methods are also available for holding in check the rodent population.

Coyotes, like other animals, crave variety in their food, hence game animals also pay heavy toll. The meat of deer and antelope is highly relished. When a coyote locates a big game animal his hunting-yelp rings out, and his fellow hunters immediately join him. Their prey runs in circles, so at certain intervals one of the coyotes drops out to "catch his wind," and lies in wait until the bewildered prey passes near him. The recuperated coyote ultimately overcomes his game, and with a single slashing stroke his powerful jaws sever the throat.

² Bell, W. B., "Hunting Down Stock Killers." Yearbook, U. S. Dept. of Agr., p. 291, 1920.

Methods of Destruction. — Various methods for controlling coyotes have been practiced since these animals first added lamb, mutton, and beef to their ration. No method has given entire satisfaction. Poisoning with strychnine in suet pellets, trapping, hunting, and digging out the dens are the methods used. Poison has killed the greatest number of adult animals, and in some localities the coyote has been almost exterminated by this means.

Strychnine is the most effective poison if properly used. Many stockmen will not admit that good results accrue from the use of poison, and insist that the animals will not touch deadly bait. This contention is about as true as it is false, for the success attained lies in the method. Old worn-out horses are often bought, or cattle that have died are used for bait. The carcass is cut up in pieces small enough to be dragged behind a saddle horse with little effort. The bait must not be touched with the hands, for coyotes know that human beings are their worst enemies, and will not touch bait that bears even the faintest trace of human scent. A chunk of meat may be dragged behind a saddle horse over the range, across trails, and down washes. This, however, is not the bait. Entire carcasses or large portions of the carcass at once arouse the suspicion of Mr. Coyote for such parts possess a strange appearance and the coyote wonders how they got there. He hesitates — and is saved. But coyotes will take up the scent of meat dragged over the range. Pieces of poisoned suet about the size of an English walnut are dropped along this scent trail. Care should be taken to have no trace of strychnine, which is exceedingly bitter, on the surface of the bait. As the animal trots along the trail he will pick up these small pieces of bait and devour them without hesitation. *Every bait that contains $1\frac{1}{2}$ grains of strychnine alkaloid in a capsule, inserted deeply into the bait, carries "death insurance" for one coyote.* Bait should be allowed to stand in a wooden receptacle for not less than forty-eight hours before using, in order to eliminate all traces of human scent.

A whole carcass should never be poisoned until coyotes have eaten well into it. Even then the best results are obtained by

placing small pieces of poisoned bait around the carcass at a distance of 20 to 50 feet.

Coyotes are difficult to trap, but since they travel in rather defined paths, traps set along or near the "beaten path" are often effective. A No. 3 "Newhouse" double spring type of trap is satisfactory. Always sink the trap in the ground, level with the surface. Then conceal it. This is done by covering the trap with light weight paper, over which is sprinkled fine grass, leaves, or other natural material. The paper used to cover the trap must be arranged so that the jaws of the trap can spring free. The trap should be fastened to a concealed log or rock, weighing 15 to 20 pounds. The coyote can drag this along with difficulty. If the trap is fastened to something solid there is danger that the coyote may pull loose. Fasten the trap to the drag with baling wire and cover the chain (Fig. 92).

Various kinds of fresh meat — cow's liver, a rabbit, or larger meat baits — may also be used. Recent studies by the U. S. Biological Survey, however, have proved that the use of the following scent is far more effective than a meat bait in trapping either coyotes or wolves:

Put into a bottle urine from coyotes or wolves, the gall, and the anal glands (these are situated under the skin on both sides of the vent and resemble small pieces of bluish fat), or the whole anal parts. In preparing 4 ounces of the mixture use one-quarter the amount of glycerine to give it "body" and to prevent too rapid evaporation, and 1 grain of corrosive sublimate to keep the fluid from spoiling. The mixture should stand in a shaded, but warm place, for a few days after it is prepared. When ready for use, shake well and scatter a few drops of the solution on weeds or ground 6 to 8 inches away from the trap. The farther from the trail the trap is set the larger the amount of scent that should be used. A little of the scent should be rubbed on the trapper's gloves and shoe soles to conceal the human odor.

A bait so prepared is also known to attract wildcats, lynxes, and mountain lions.

Before setting the trap many successful trappers rub their hands and feet with oil of anise. This is a good precaution, as



FIG. 92. — TRAP SETS FOR WISE STOCK-KILLERS, IN POSITION BUT NOT BEDDED.

(a) Open set; (b) Carcass set; (c) Trail set.

any strong odor attracts the attention of the coyote and allays his suspicion. When a line of traps is set they should be visited every day. The trapper had best go on horse back in order to avoid leaving any human scent along the path.

Dogs are a great help in hunting coyotes. Large, powerful, fleet-footed dogs, like the larger foxhounds, staghounds, or Russian wolfhounds, are best. To overcome and kill the coyote safely, the dogs should be worked in teams of not less than three. Add to the pack of dogs a good rifle shot, and considerable can be done toward ridding a community of coyotes.

Coyote drives, in which the whole community participates, are also effective means of holding the numbers of coyotes in check.

Bounties. — In many states the warfare against coyotes has been stimulated by bounties paid from the treasury of the state or county. The bounties paid vary from \$1.50 to \$5.00. In some parts of the West both bounty and awards from individual stockmen and from livestock associations are offered for the coyote's scalp.

That the bounty plan has been effective in many places can not be denied. However, because of lack of uniformity in the payment of bounties, the results generally have not been commensurate with the expense. The chief objection to bounties is an ethical one, for they often lead to fraudulent practices.

In 1915 the U. S. Biological Survey was authorized by Congress to formulate an organization for the purpose of destroying predatory animals. The work of this Bureau has been highly effective, and has held these livestock killers in check better than any other method.

Rabies among Coyotes. — There is an occasional sporadic outbreak of rabies or hydrophobia among coyotes. The disease usually results in the destruction of a large number of coyotes in the infected area. Control of coyotes in this way, however, is invariably accompanied by loss of life among humans and livestock.

The greatest danger to persons is that domestic dogs may be bitten by the diseased coyote. Dogs so affected have been known to transmit the disease to an entire family.

The spread of the disease can best be prevented by killing the diseased coyotes along the borders of the infested districts. Following this, the infected districts themselves should be cleared of the mad animals and the disease stamped out.

MOUNTAIN LION, COUGAR, OR PANTHER (*Felis* spp.)

The mountain lion (*Felis cougar* and its subspecies) weighs between 150 and 200 pounds and is the largest member of the cat tribe in this country (Fig. 93). It is found in North and South America wherever there is big game.

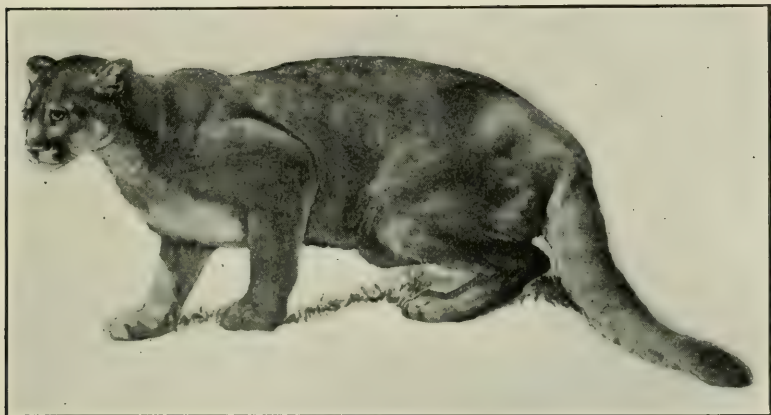


FIG. 93. — MOUNTAIN LION, COUGAR, OR PANTHER.

Because of the favoritism they show for beef, horse, and mule meat, mountain lions are enemies of the cattle and horse breeders on the western ranges. The mountain lion is a shy, keen-scented beast, with sufficient cunning to keep out of a cleverly set trap, but relatively easy to capture with trained hounds. Cat-like, the lion has a tendency to follow human beings in an uncanny way, but he seldom attacks man.

There are usually two or three young to a litter, but as many as four have been reliably recorded. As soon as they are old enough to run with the mother they follow her in the hunt and eat part of the game she kills.

In cattle- and horse-raising regions colts and calves are com-

monly preyed upon by lions. In Arizona one lion killed nine head of cattle in a few weeks. Although the destructiveness of lions is not so serious as that of the coyote or wolf, it causes a formidable annual loss to stockmen. Lions are also fond of all kind of game animals, but the meat of the deer, the elk, and the mountain sheep is especially relished. They are cunning hunters and secure their prey by stalking silently until they are within springing distance. Then with a leap the victim is dashed to the ground.

Methods of Destruction. — When their control is seriously undertaken, mountain lions can be held in check by hunting with hounds. When closely followed by dogs the lion will seek safety by climbing a tree, where he can be shot easily. Poisoning and trapping are also employed with reasonable success.

GRAY OR TIMBER WOLF (*Canis* spp.)

The larger wolves, commonly known as “loafers” or “lobos,” embrace no less than six distinct species. The large gray or

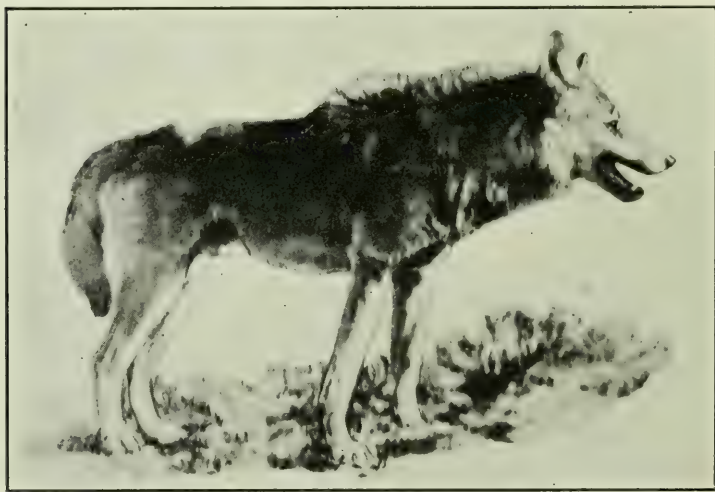


FIG. 94. — GRAY OR TIMBER WOLF, THE CATTLEMAN'S WORST ENEMY.

timber wolf of the plains and mountains (*C. nubilus*) is the species most numerous in the United States (Fig. 94). Since the habits and destructiveness of the various species are much the same a

discussion of specific taxonomy is not important here. Species of the true wolf are widely distributed, one form or another being found practically everywhere in North America.

Because of the extreme destructiveness of the wolf among foraging animals, it is important to distinguish between the true lobo (wolf) and the small wolf (coyote). The shrill yelping of a coyote is distinctive as compared with the deep-chested voice of the timber wolf. When an animal has been caught and can be examined the following distinctive points are helpful in determining whether it is a wolf or a coyote:

<i>Points</i>	<i>Wolf</i>	<i>Coyote</i>
Weight.....	60-100 pounds	25-45 pounds
Weight of skull (cleaned).....	14 ounces	9 ounces
Width of nose pad.....	$1\frac{1}{4}$ - $1\frac{1}{2}$ inches	$\frac{3}{4}$ -1 inch
Width of heel pad of front foot.....	$1\frac{1}{2}$ -2 inches	$\frac{7}{8}$ -1 inch
Upper canine teeth.....	$\frac{1}{2}$ - $\frac{6}{10}$ inch	$\frac{3}{10}$ - $\frac{4}{10}$ inch
Claws, diameter at base.....	$\frac{3}{8}$ - $\frac{1}{2}$ inch	$\frac{1}{4}$ - $\frac{5}{16}$ inch
Head of young pup.....	grayish	yellowish-gray

Wolves, like coyotes, breed mainly in the foothills and plains and are rarely found on mountain ranges in winter. They leave the mountains with the livestock late in the autumn and do not return until the young members of the family, which are generally born in March, April, or May, are old enough to take care of themselves.

Midwinter is the mating period of wolves. The average litter is from five to eight, though more have been reported. The breeding dens are usually located along the bad-land slopes of the foothills where there are good sentry posts from which the male can watch for the approach of enemies.

The food habits of the gray wolf are much the same as those of the coyote, except that the wolf feasts more on the larger animals. Formerly the wolf subsisted mainly on bison, but for this delicacy he has now substituted cattle. Calves and yearlings are generally selected, but if these are not obtainable wolves will kill cows and even full-grown steers. The animal is generally attacked from behind, and the few animals that escape with a bite in the quarters usually die from blood poisoning. Wolves are particu-

larly destructive because, unlike the coyote, they prefer making a fresh kill to returning to a partly eaten carcass. It is estimated that on the average each wolf destroys not less than \$1000 worth of livestock annually. A notorious wolf killed at Nutt, New Mexico, is authoritatively reported to have killed in six months 150 head of cattle, worth at least \$5000.

Colts, sheep, goats, hogs, and all of the larger game animals are included in the wolf's menu. Grown horses are not often victims of the wolf, presumably because of his habit of attacking from the rear. Herded sheep are seldom troubled by wolves owing to the presence of the herder and dogs, but unherded and stray sheep are killed with a vengeance. Wolf-proof pastures for sheep raising have proved economical in certain wolf-infested regions.

Methods of Destruction. — The methods used for the destruction of coyotes are generally efficacious in reducing the number of wolves in any section.

In trapping, No. 4 double-spring traps, with welded chain, should be used. The bait should be the same as that for the coyote, except that 2-grain capsules of strychnine should be used.

BOBTAILED CATS (*Lynx* spp.)

These short-tailed, big-footed cats, collectively called bobcats or wildcats by stockmen, cause the sheep raisers serious losses in many localities.

Bobtailed cats of the genus *Lynx* are of two distinct types: Canada lynx (*L. canadensis*), and wildcat (*L. rufus*), the latter embracing many subspecies and possibly closely related species. Both types are found throughout North America from the Atlantic seaboard to the Pacific. The Canada lynx is of more northerly distribution and inhabits the Boreal life zones, whereas the wildcat is found in the mountains and low lands farther south.

The average weight of an adult bobtailed cat is about 25 pounds. In color wildcats vary from buff to rich ochraceous gray, with heavily spotted belly, sides, and flank (Fig. 95). The common Canada lynx is readily distinguished from the true bob-

cat by its large feet, long legs, and especially by the solid black tip of the short tail.

The food habits of wildcats and lynx are practically identical. "The fattest lamb in the band" is often selected by the wildcats in sheep-raising regions. Cats seem to kill lambs and the young of big game animals chiefly for the blood as they eat only a small

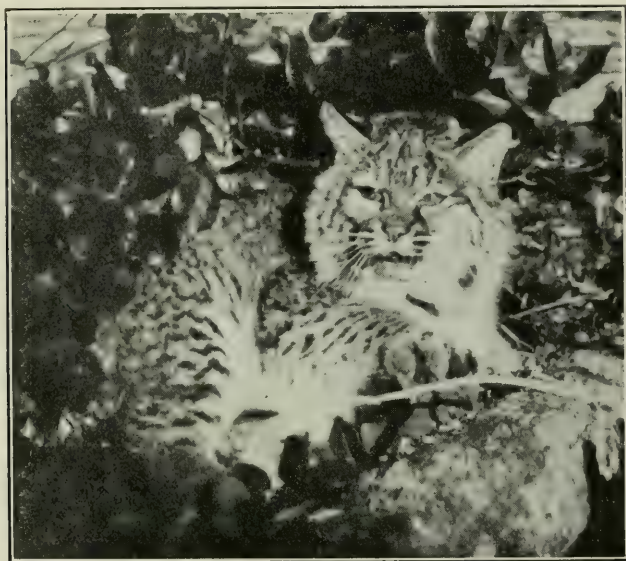


FIG. 95. — BOBTAILED CAT, OR WILDCAT.

portion of the carcass. They are reputed to kill large numbers of young mountain sheep, deer, antelope, and other game animals. They also feed freely upon rabbits, pocket gophers, squirrels, field mice, and other vegetation-destroying mammals.

Methods of Destruction. — Wildcats are easily kept under control by trapping them and by hunting them with good trail dogs. They lack the cunning of the coyote or wolf and are not difficult to trap. Moreover, because of their habit of taking refuge in trees, they are easily shot. A No. 3 double spring steel trap is satisfactory for trapping them. The traps are set and baited as for coyotes.

BEAR (*Ursus* spp.)

Bruin gets more than his share of "cussing" from the stockman. In New Mexico a Biological Survey hunter killed a grizzly (*Ursus horribilis*) that had killed thirty-two head of cattle during the spring and was known to have killed fifty cattle the previous year.

Although bears are sometimes the cause of losses in sheep and goats, such losses are generally caused by the animals becoming frightened and stampeding, piling up, and smothering; or, if bedded near a precipice, by their falling over the ledge. Although one bear out of a dozen may become addicted to the mutton or beef-eating habit, it is incorrect to class bears generally with predatory animals. Certainly they are not predaceous to the same extent as the carnivores previously discussed.

Bears are exceedingly shy and timid, and are seldom seen. They rarely attack a human unless wounded or cornered so that they must defend themselves or their young. They possess keen sense of smell and hearing, and rely upon these to enable them to avoid danger.

The young are usually born in May or June. There are one or two cubs to a litter. Adult black or brown bears (*U. americana*) weigh from 250 to 400 pounds (Fig. 96), whereas the grizzly sometimes weighs over 1000 pounds. As a rule, bears retire to dens about November and hibernate until early spring.

The food of bears consists both of animal and vegetable life, chiefly the latter. Early in the spring they eat large quantities of roots, bulbs, tender flower stalks, the foliage of a great variety of broad-leaved plants, and the tender blades of many grasses. Later, berries of various kinds and particularly huckleberries furnish food that is much relished.

"There is no evidence that the bears molest any large game, and the scouts and old hunters say that they do not."³ Late in autumn when vegetable food becomes scarce, they dig out the burrows of hibernating squirrels and these fat little fellows furnish

³ Bailey, Vernon, "Wild Animals of the Glacier National Park." Dept. of Interior, p. 95, 1918.

bears with considerable food. Being natural scavengers, black and brown bears consume large portions of carcasses, but, as stated, they seldom kill large foraging animals. The grizzly, of which few remain in the United States (probably none remain in California), sometimes kills livestock.



FIG. 96. — BROWN MOTHER BEAR AND HER BABES.

Methods of Destruction. — Bears are hunted and trapped successfully. When closely pursued by dogs, black and brown bears are not difficult to tree. The grizzly, however, cannot climb trees, and is hunted with less success.

In trapping, meat, honey, or fresh fruits are used effectively for bait. Poison is also employed more or less successfully. A 5-grain capsule of strychnine alkaloid is inserted in the bait and placed near wallows and other places frequented by bears.

SHEEP-KILLING DOGS

Trustworthy and devoted as dogs usually are, there are times when they lead double lives. By day they follow their masters and respond cheerfully to commands, but at night they sometimes slink off to the neighbor's sheep lot or pasture and commit untold crime.

Were it not for the dog menace, the number of sheep raised in states other than those in the far West might be increased greatly. Between 1900 and 1910 the number of sheep on farms decreased 3,900,000 head, despite the fact that their market value in 1910 was approximately 25 per cent more than in 1900. Stray dogs were chiefly responsible for this decline.

Number of Sheep Killed by Dogs. — Although the exact number of sheep killed annually by dogs is not known, the records show that more than 100,000 sheep meet their death each year by dogs,⁴ the annual loss being nearly 1 per cent in the farm states.

Those who have seen sheep killed or injured by dogs are not likely to go into the sheep-raising business. If the dog menace could be controlled effectively the number of sheep kept on farms would no doubt increase rapidly. In Great Britain there is one sheep or lamb to each 2.5 acres of total area. In the thirty-six farm states in this country there is only one sheep or lamb to 31 acres.

Control of Vagrant Dogs. — State laws differ widely in their disposition of the dog evil. Some states use the money obtained from the dog-license tax to reimburse owners of dog-injured sheep; others permit the sheepmen to recover the damages from dog owners. Obviously, these regulations do not strike at the root of the evil. It has been suggested that a uniform state dog law should be enacted which would place so heavy a tax upon dogs that the owners would look after the whereabouts of their canine friends. It has also been advocated that when a dog is found running at large he should be killed. As a protection to the industry, sheep growers have proposed that any dog known to have molested sheep should be killed. The money collected for dog taxes should be used to reimburse sheep raisers for the animals maimed or killed. In localities where the dog menace is of more than usual seriousness, sheep raisers should resort to the use of dog-proof pastures.

⁴ Wilson, J. F., "The Sheep-Killing Dog." U. S. Dept. of Agr., Farmers' Bul. 935, p. 4, 1918.

RODENTS AND THEIR CONTROL

It has been conservatively estimated that rodents destroy annually \$150,000,000 worth of range forage and cultivated crops of equal value.⁵

To overcome this loss may seem a hopeless task, but by organized effort the destruction of crops by rodents can be very materially decreased. Control measures, however, require concerted and continuous action by many agencies. The combined efforts in rodent control have recently afforded a good example of coöperative spirit among stockmen and farmers and county, state, and federal organizations.

Not many years ago, in some localities, rodents ate up the margin of profit in crop production. Attempts by farmers and stockmen to clear their holdings of rodents failed because the methods of control were ineffective. Enormous sums were expended for bounties, a plan of control which resulted in depleted treasuries and practically no diminution in the rodent population. It was not until the Biological Survey of the U. S. Department of Agriculture was given funds for the study of methods of eradicating rodents and for putting their findings into field application that effective control was made possible.

PRAIRIE DOG (*Cynomys* spp.)

Prairie dogs are rodent cousins of ground squirrels. They are larger than most ground squirrels. The adult prairie dog is a stout-bodied creature about a foot long, with short, full fur, and a short, flat tail, which in the more numerous subspecies is tipped with black. The ears are small, the teeth heavy and built for gnawing, and the claws long and suited for digging. Prairie dogs live in burrows in the ground, the entrances to which are crater-shaped mounds of earth 3 to 10 feet wide (Fig. 97).

These rodents, conspicuously numerous over their range, are confined to the interior of North America, Colorado being about the center of distribution. None are found in the states of the Pacific Coast.

⁵ Bell, W. B., "Death to the Rodents." Yearbook, U. S. Dept. of Agr., pp. 421-23, 1920.

The food of prairie dogs consists of fleshy bulbs, roots, seeds, and the leafage of various kinds of herbs. They eat the herbage so closely that the ground around old, heavily populated prairie-dog colonies is nearly devoid of every vestige of vegetation.

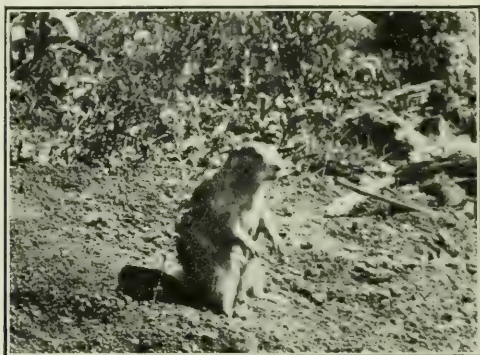


FIG. 97. — PRAIRIE DOG AND HIS CHARACTERISTICALLY DENUDED HAUNT.

"Twenty prairie dogs are thought to eat and spoil more grass per annum than is necessary to keep one sheep."⁶

It is difficult to estimate the damage to the range caused by prairie dogs, because the colonies shift from one area to another. On thousands of square miles they eat from 50 to 75 per cent of the forage annually.⁷

The use of poisoned bait is the only effective means of controlling the prairie-dog pest. Fumigation of the burrows with various poisonous gases has been found tedious and expensive.

The following directions for poisoning prairie dogs have been developed by the U. S. Biological Survey:

Dry gloss starch.	1 heaping tablespoonful
Strychnine (alkaloid), powdered.	1 ounce
Baking soda.	1 ounce
Corn sirup.	$\frac{1}{4}$ pint
Glycerine.	1 tablespoonful
Saccharine.	$\frac{1}{10}$ ounce
Clean oats.	13 quarts

⁶ Smith, Jared, G., "Grazing Problems in the Southwest and How to Meet Them." U. S. Dept. of Agr., Div. of Agrost. Bul. 16, p. 14, 1899.

⁷ Taylor, Walter P., and Loftfield, J. V. G., "Damage to Range Grasses by the Zuni Prairie Dog." U. S. Dept. of Agr. Bul. 1127, 1924.

"Dissolve the dry gloss starch in a little cold water and add $\frac{3}{4}$ pint of hot water. Boil, stirring constantly, until a thin clear paste is formed. Mix together the powdered strychnine (alkaloid) and baking soda, sift into the hot starch paste, and stir thoroughly to a smooth creamy mass. Add the corn sirup, glycerine, and saccharine and stir thoroughly. Pour this mixture over the oats and mix thoroughly so that each grain is evenly coated. (It is important that only the best grade of thoroughly clean oats be used, as chaff absorbs and wastes much valuable strychnine, and poisoned weed seeds imperil useful bird life.)

"Each quart of the prepared grain is sufficient to treat about 40 holes. This quantity should be sparingly scattered on clean hard ground near each prairie-dog hole. Do not place the poison on loose or dusty ground or in the holes. With reasonable care in scattering the bait, livestock on the open range will not be endangered. The poison is effective at any time that prairie dogs are active."

Where applied as directed, this formula is effective in ridding the lands of prairie dogs. Systematic effort is needed to eradicate the prairie-dog evil, however, for to destroy them in one pasture and not in the adjoining one is to work to no purpose.

JACK RABBIT (*Lepus* spp.)

All jack rabbits are related to the hares of the Old World. The black-tailed jack rabbit (*L. californicus*) is well known to stockmen as it is abundant in the treeless foothill and valley lands in middle North America, ranging from Minnesota and Texas to the Pacific Coast (Fig. 98).

Jack rabbits do not burrow but build forms in grass and brush for concealment and for the young. They are preyed upon by many enemies, notably coyotes, wolves, wildcats, hawks, eagles, and owls, and as a result of this they are cunning and cautious.

Since the settlement of the country the jack rabbit has devastated fields and pastures, sometimes entirely destroying the crops and forcing settlers to abandon their agricultural pursuits. In some sections of the West, entire communities take part in jack-rabbit drives. This is good sport, and, locally, rather effective in controlling the number of animals.

Rabbits of all kinds are easily poisoned in winter when green

feed is scarce, as they will eat well-cured alfalfa or clover hay eagerly at that time.

A formula which is extensively used is made up as follows: 10 pounds of alfalfa or clover leaves over which is sprinkled 2



FIG. 98. — JACK-RABBIT DRIVE, A GOOD SPORT AND HELPFUL IN SUPPRESSING THE PEST.

gallons of hot water in which has been dissolved 1 ounce of strychnine sulphate. The leaves should be mixed thoroughly until all moisture is absorbed.

The poison should be distributed in small handfuls where the rabbits have been feeding. After snow falls it is well to take the precaution to distribute poisoned alfalfa in corrals or pastures from which stock is excluded.

GROUND SQUIRRELS (*Citellus* spp.)

Ground squirrels, or spermophiles, inhabit the states of the Middle West and extend to the Pacific Coast (Fig. 99). Many species are represented.

They are more or less omnivorous as they sometimes subsist on flesh and insects, but mostly they feed upon foliage, seeds, and fruits. The destruction of pasture, forage, and farm crops by ground squirrels is appalling, amounting each year to more than

\$15,000,000 in California alone. The abundance of the California ground squirrel in California and adjoining states is probably not exceeded by that of the prairie dog in his most favorable habitat.

Squirrels feed so greedily on green vegetation that it is difficult to poison them when the vegetation is succulent. They are fond

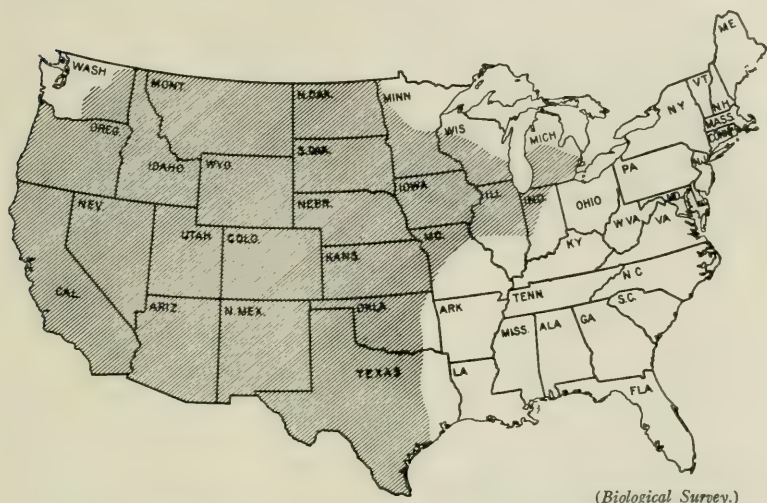


FIG. 99.—DISTRIBUTION OF GROUND SQUIRRELS IN THE UNITED STATES.

of grain, however, and will take poisoned grain, particularly barley, freely in spring and autumn. The following well-tested formula is recommended:

Mix together, dry, 1 ounce of baking soda, 1 ounce of powdered strychnine alkaloid, 3 teaspoonfuls of flour, and 1 teaspoonful of saccharine. Add just enough water to the mixture so that it will stir into a creamy paste. Then mix the concoction thoroughly with 12 quarts of bright barley or oats.

The poisoned grain is scattered, a teaspoonful to a spot, along squirrel runs, preferably on hard ground, where stock is excluded.

When house rats brought the bubonic plague to San Francisco a few years ago they carried the disease to the foothills near Oakland and infected the California ground squirrel. In this way the disease spread to several adjoining counties. To safeguard

the public the California ground squirrel should be definitely controlled, if for no other reason than to prevent future outbreaks of the dreaded plague.

POCKET GOPHER (*Thomomys* spp.)

Pocket gophers, or "tuzas," are confined to North America where they are widely distributed, mostly over the treeless lands (Figs. 100 and 101).

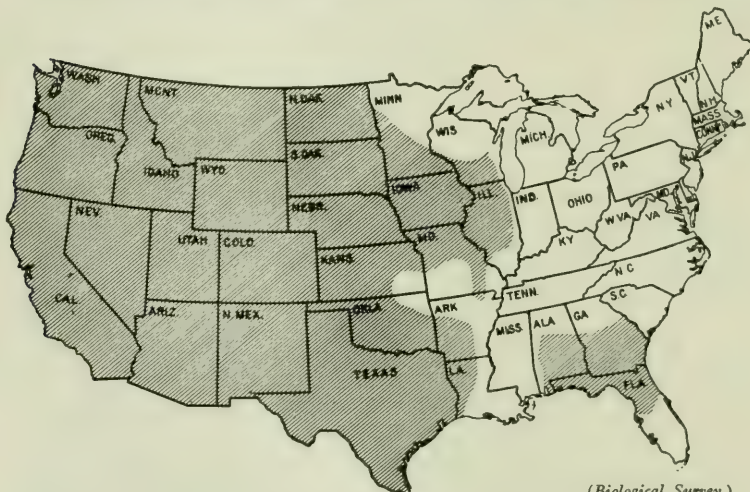


(E. T. Seton.)

FIG. 100. — POCKET GOPHER, BUILT FOR BURROWING.

The food of pocket gophers consists of fleshy stems, tubers, bulbs, and fibrous roots. In irrigated areas they burrow in ditch banks while searching for food, and often cause serious breaks.

Pocket gophers seldom leave their burrows, and although they can be trapped, the job is tedious. A much more



(Biological Survey.)

FIG. 101. — DISTRIBUTION OF POCKET GOPHERS IN THE UNITED STATES.

practicable method of ridding a field of them is to poison them. This can be done effectively by placing baits of poisoned sweet potatoes, carrots, or parsnips in their underground runways.

The baits should be cut in $\frac{1}{2}$ inch squares. Over 4 quarts of the dampened bait, sift uniformly $\frac{1}{8}$ ounce of powdered strychnine alkaloid and $\frac{1}{10}$ ounce of saccharine ground together. Then stir thoroughly to distribute the poison evenly.

The runways can be located readily by forcing a blunt-ended stick into the ground at intervals. When a runway is located a piece of bait is dropped into the hole made by the probe, after which the hole is closed. This method has proved effective and has found favor wherever used.

Pocket gophers have many enemies, such as weasels, badgers, and coyotes, but the most formidable are the barn owls and the bull or gopher snakes. The owl and snake, both harmless to man, should be protected as their main diet consists of gophers.

QUESTIONS

1. Compare the financial losses caused by predatory animals and by rodent pests on the range.

2. (a) Name, in the order of their destructiveness, the predatory animals most common in the United States. (b) Discuss the food habits of coyotes. (c) How are the numbers of coyotes usually controlled? (d) Which method is the most effective?

3. (a) Discuss the characteristics of the mountain lion. (b) What is the favorite meat of mountain lions among domestic grazing animals? (c) Discuss the degree of their destructiveness. (d) How may the population of mountain lions be most effectively controlled?

4. (a) How does the destructiveness to livestock of the wolf, animal for animal, compare with that of the coyote? (b) Discuss methods of destroying wolves. (c) Compare the habitat, reproduction, and food habits of wolf and coyote.

5. (a) Compare the distribution of lynx and wild cats. (b) Upon what foods do bobtailed cats chiefly subsist? (c) Discuss the more approved methods of destroying bobtailed cats.

6. (a) To what extent do bears prey upon domestic herbivora? (b) Discuss the food habits of bears. (c) What methods are most effective in destroying bears?

7. (a) To what extent do sheep-killing dogs cause losses in farm flocks? (b) Discuss fully the methods proposed for curbing the evil of the sheep-killing dog.

8. Discuss the work of the U. S. Biological Survey in the control of rodents on the range.

9. (a) What are the habits of prairie dogs? (b) Discuss the food habits of these rodents. (c) Discuss one effective means of controlling the prairie-dog population.

10. (a) To what extent do rabbits, particularly certain species of jack rabbits, destroy forage and fodder crops? (b) Discuss methods of controlling the rabbit pest.

11. (a) Discuss the feeding habits of ground squirrels and pocket gophers. (b) What are some of the more effective means of controlling these range pests?

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CHAPTER XXI

WILD ANIMAL LIFE AND RECREATION AREAS: THEIR RELATION TO LIVESTOCK PRODUCTION

At first thought, wild animal life, recreation areas, and livestock grazing would appear to bear no relation one to the other, but as a matter of fact they are closely connected.

Many of the nation's recreation areas afford fine breeding grounds for native animals of many kinds, and the very presence of the animal life lures the public to these haunts. On the other hand, an over-production of the native animals, like too heavy grazing by domestic livestock, may appreciably decrease the attractiveness of the recreation areas, and ultimately be the cause of reducing the population of the most desirable animals. Unrestricted livestock grazing likewise may upset the desired balance in the wild animal life and decrease the attractiveness of recreation lands. This chapter aims to outline the present status of our wild life and recreation grounds, and to consider certain means of maintaining the desired balance in land uses.

Animal Life in Frontier Days.—In frontier days North America contained mammalian and aquatic animal life equaled in historic times only in Africa. In the north, beyond the limits of arborescent vegetation, great herds of caribou and musk-oxen grazed on the dwarf vegetation. Southward, multitudes of woodland caribou and moose roamed in the forested stretches. Still farther south, nature's haunts were inhabited by millions of buffalo, antelope, elk, deer, mountain sheep, and mountain goats. Occupying the land with them were various carnivores, notably bear, wolf, coyote, mountain lion, and lynx. Fur-bearing animals, such as the beaver, muskrat, land and sea otter, marten, and fox, were so abundant that immediately after colonization took place North America furnished the world's supply of furs.¹ During the past century, however, the home-

¹ Nelson, Edward W., "Wild Animals of North America." Nat'l Geographic Society, Wash., D. C., pp. 385-407, 1918.

steading of much of the fertile frontier country, and the increasing commercial demand for furs and other native animal products, have caused the population of most of the larger animals to decline alarmingly.

Value of Game. — Few persons fail to admire a well-vegetated landscape of meadow or forest, but its attractiveness and usefulness are greatly enhanced by the presence of wild animal life.

It has been said that the esthetic qualities of wild animal life are its most valuable asset, and this is particularly true of big game. Natural woodlands and other uncultivated areas are of unquestionable value to the public because they awaken in the vacationist his physical, mental, and esthetic senses. The entire environment, however — plant and animal, and indeed the geological formations with their delicate colorations and extraordinary erosional phenomena — appeal powerfully to the seeker of rest, beauty, sport, and study.

Fur-bearing and wild game animals everywhere have appreciable monetary value. Certain states have estimated the money value of the game killed within their borders. In each of eight states — Idaho, Michigan, Minnesota, New York, Oregon, Pennsylvania, Vermont, and Wisconsin — the annual yield exceeds 25 million dollars.

There is another side to the monetary value of animal life, namely, the beneficial effects on the forest itself. "There can be no snappy and full-fleshed trout in the brook without adequate insect life to feed upon. There can be no insects without suitable plant food for their subsistence. There can be no singing finches and grosbeaks in the glades without seeds and fruits for them to feed upon. There can be no warblers in the tree-tops unless there be an unfailing supply of 'bugs.' There can be no foxes and weasels to thrill us momentarily when we come upon them, without rodents for them to feed upon. There can be no gay and frisky chipmunks without seeds to feed upon. There can be no seeds unless the annual crop of vegetation has been left to mature."²

² Grinnell, Joseph, "Wild Animal Life as a Product and as a Necessity of National Forests." *Journal of Forestry*, Vol. 22, No. 8, p. 838, 1924.

A reserve nucleus of bird life should be maintained at all times as insurance against serious insect pests. Likewise, insects of most species peculiar to a habitat should be present in sufficient numbers to furnish food for birds and other animals that depend upon them for nourishment. It is of importance to the public that a reasonable balance be maintained in the animal population. This so-called "balance of nature," however, does not apply in the unchecked reproduction of enemies of big game, for the inroads made upon game animals by beasts of prey are very serious. The coyote, the wolf, and the members of the cat family must be suppressed. Thus it is not the claim that all animal life is at all times and under all conditions beneficial even to the forest. Porcupines often feed vigorously upon the bark and tender shoots of conifers, sometimes completely girdling and killing many vigorously growing young trees within a single season. Some insects are clearly destructive to trees and other vegetation, causing defoliation or destruction of vital plant parts. In many instances, fortunately, effective control measures are available.

Natural Breeding Grounds.—Because both the National Forests and the National Parks are the natural breeding grounds for game, it is important to know wherein they differ.

The purpose of the National Forests is to maintain and perpetuate, for permanent use by the public, forest resources—timber, forage, water, minerals, recreation, and game. The wealth of the Forests is exploited only to an extent which is consistent with permanent productivity under coördinated use.

The primary purpose of the National Parks is to preserve within their borders all scenic and historic values, and all plant and animal life. National Parks are for the enjoyment and education of the public and to aid and encourage scientific research. Their resources are not subject to exploitation. The National Forests are administered by the Forest Service of the U. S. Department of Agriculture. The National Parks are administered by the Park Service of the Department of the Interior. The acreage of National Forest lands is many times greater than that of the National Parks.

The greatest opportunity in the United States for the perpetuation and maintenance of wild life of all kinds is on the National Forests. State and National Parks also are valuable breeding grounds for game; but, compared with the National Forests, the parks are greatly limited in area, in variety of forage types, and in climatic conditions, consequently in the number of animal species. The National Forests offer adequate protection to game and are the natural breeding grounds for the big game.

IMPORTANT BIG GAME ANIMALS

Where adequate protection and suitable breeding grounds are provided for big game, protection is afforded also for the perpetuation of most of the associated animal species. It is in place, therefore, to consider briefly the habits, distribution, and reproductive requirements of the more important species of hoofed big game animals, of the Order *Ungulata*, which embraces buffalo, sheep, goats, antelope, and the members of the deer family.

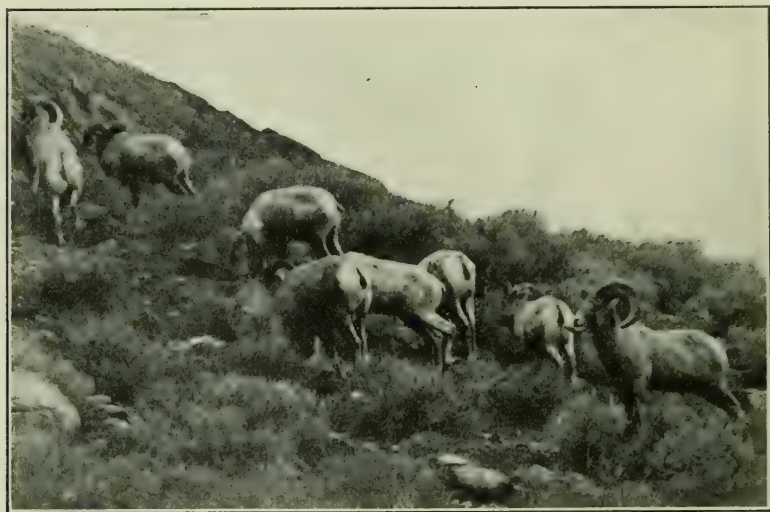
Buffalo, or Bison (*Bison bison*). — The family *Bovidae*, which embraces all species and subspecies of cattle, includes that characteristic quadruped of the plains, the buffalo. The family also includes sheep and goats.

The North American buffalo is closely related to the larger bison which is a native of Europe. The size and color and the ruggedness of the coat, the large, coarse head, and the arched, powerful shoulders make the buffalo unique. Enormous numbers of these animals once roamed the plains and less-elevated forests in nearly all of our states. The advent of the trans-continental railroads spelled disaster to the buffalo herds, and the species was at one time in danger of extermination. The danger of extermination has passed, however, and today there are in North America about 12,000 head, this number being rather evenly divided between the United States and Canada. Approximately 2500 calves are dropped each year. Buffaloes may be compared with domestic cows in productivity and forage requirements. They are hardy, easily raised, and comparatively free from disease.

Crossing the buffalo with domestic cattle has been tried with a view to improving the hardiness of the latter; but these experiments have not proved of practical value, partly because of the lack of fertility of the "cattalo," or hybrid.

The buffalo was the Indian's most dependable game animal. It furnished much of his food and shelter, and entered into his life and customs more than did any other native mammal.

Rocky Mountain Sheep, or Bighorn (*Ovis canadensis*).—There are probably three distinct species of native sheep in North



(Biological Survey.)

FIG. 102.—ROCKY MOUNTAIN SHEEP, OR BIGHORNS.

America, the best known being the Rocky Mountain sheep, or bighorn (Fig. 102). This species is found from British Columbia to Colorado and northern New Mexico (Fig. 103). These animals are dwellers in the upper world — feeding commonly at or above timberline in summer and the lower ridges in winter. The young, numbering one or two, are dropped in May and June in the crags above timberline, where they remain until the snow drives them to lower plant zones. They live on a variety of food plants, presumably because of the scant growth of any one plant species in these wind-swept, icy haunts.

In summer their food consists largely of leafage, buds, and tender twigs, herbaceous vegetation, and a small amount of grass. In winter, sheep take almost any of the vegetation on the rough slopes and cliffs, grazing off whatever is exposed above the snow or projects from the cracks and crevices of cliffs and ledges.

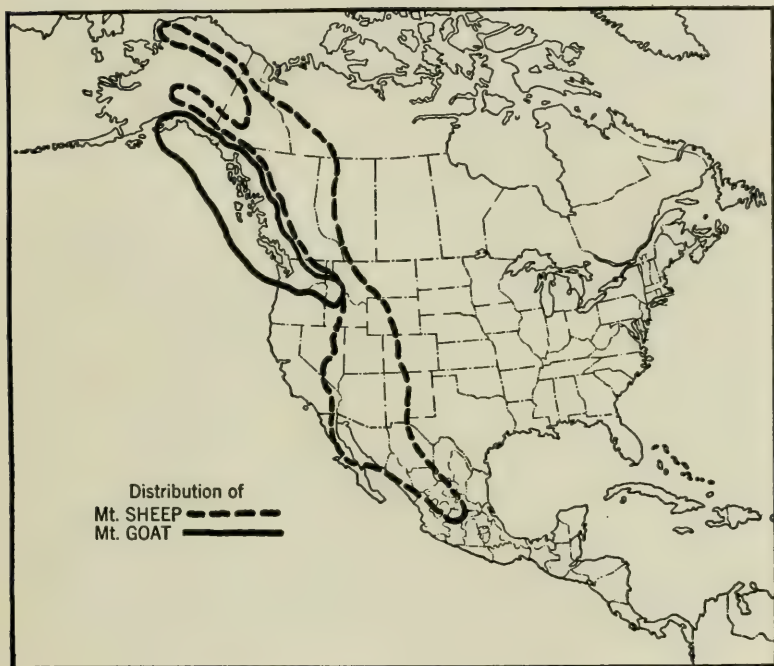


FIG. 103. — DISTRIBUTIONAL RANGE OF ROCKY MOUNTAIN SHEEP AND ROCKY MOUNTAIN GOATS IN NORTH AMERICA.

The sure-footedness, climbing capacity, and springy gait of mountain sheep are outstanding characteristics of the species. The meat is considered a delicacy and is of very fine flavor. The big mountain coyote is the worst enemy of the sheep. By holding these beasts of prey in check, it should be possible to bring about a rapid increase in the numbers of mountain sheep.

Rocky Mountain Goat (*Oreamnos montanus*). — The white or Rocky Mountain goat is the only representative of the genus in

North America. It is readily recognized by the long, slender head, the small, black, unbranched horns, and the coat of shaggy white hair covering a heavy, ungainly body (Fig. 104). The range is from Alaska through the mountains of Montana and Washington (Fig. 103).

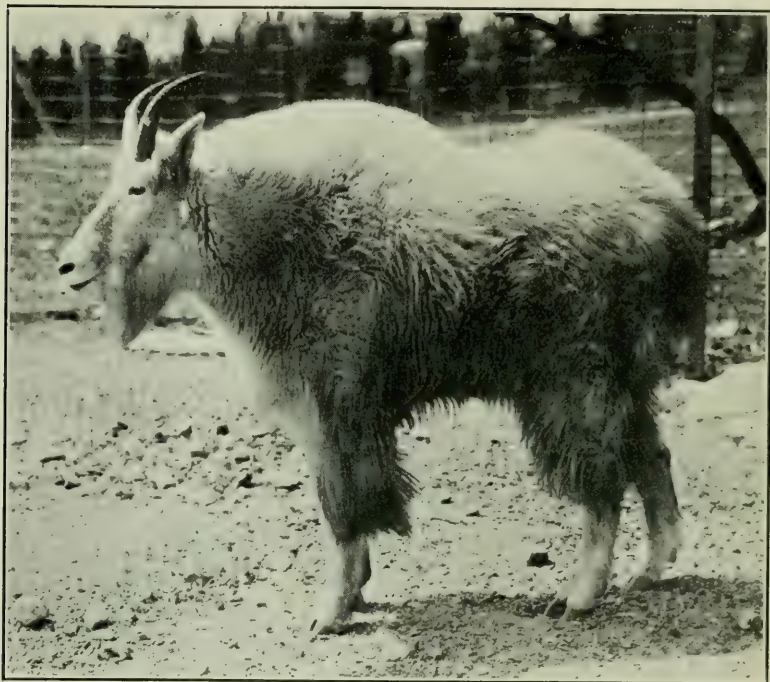


FIG. 104. — WHITE OR ROCKY MOUNTAIN GOAT.

Goats confine themselves yearlong to crags, ridges, and rugged slopes. Occasionally they cross from one range to another, but they do not make as great a vertical migration up and down the slopes of the mountains as do mountain sheep. Usually they travel up the slopes to high ledges during early morning, where they feel safe and sleep until late in the afternoon. By sundown they are feeding in alpine meadows near timberline.

In winter they are found on the crests of ridges at high altitudes, where dwarf vegetation is exposed and serves as food.

Goats do not prefer grass but live on dwarf willow and various broad-leaved herbs, such as sorrel (*Oxyria*) and *Phacelia*, using various species of alpine grasses and sedges as fillers.

Although sure-footed and fearless of precipitous slopes, goats are not especially graceful and their movements are rather deliberate. Inhabiting areas not commonly visited by man, they are not fearful of his destructiveness and are tamer than most game animals. Because the flesh is not palatable to man, they are less hunted than most big game. The kids, one or sometimes two from each "nanny," are dropped in May and June. When a month old they seem to climb as well as the older members of the family. With reasonable protection, the goat will long occupy a place among the big game of this country. Its principal enemy is the coyote.

Prong-horned Antelope (*Antilocapra americana*). — The prong-horn, a member of the family *Antilocapridae*, is probably the fleetest and among the most graceful of the ruminants (Fig. 105). In size the prong-horn is similar to the smaller forms of Virginia deer. The hair is brittle and coarse and the skin is spongy and lacks firmness. The rump patch is white, and in moments of excitement or alarm, the long, rather stiff, white hairs rise on end, forming conspicuous rosettes. These rosettes reflect the sunlight, and heliograph the danger to other grazing antelopes. Both sexes are provided with horns of a peculiar sort. The horns of the doe are slender and small compared with those of the male. Both sexes shed the horns in autumn.

Antelope were probably the most numerous of all big game in frontier days. The natural range is from Alberta to Mexico and from the Middle West to the Pacific Coast (Fig. 106). They are, like the buffalo, inhabitants of the plains and were commonly associated with the bison. The American antelope is highly sensitive and of a nervous temperament, and fails to reproduce regularly when disturbed. If confined, as in fenced areas, it soon dies. The fawns are dropped in the spring. During the mating season, which is in the autumn, the herds seem to run in small "harems," a male gathering together a dozen or more does.

Moose (*Alces americanus*). — The moose, a member of the family *Cervidae* (as are also the caribou, reindeer, elk, and deer), because of its large size and grotesque body, is the most distinctive of our larger grass eaters. Its coarse, big head, prominent



(Paul Fair.)

FIG. 105. — A PAIR OF PRONG-HORNED ANTELOPE.

protruding nose, enormous palmated antlers, which often have a spread of 6 feet or more, short body, and long legs combine to give the appearance of remote relationship to its elk cousin (Fig. 107). The larger bulls attain a weight of more than 1400 pounds. The moose inhabits forests of the Northland, from the Yukon and the lower Mackenzie to Maine and the Great Lakes region and the Rocky Mountains of Wyoming (Fig. 106). In summer it inhabits the warmer swampy forests, where, mostly

at night, it feeds upon succulent and aquatic vegetation, found in lakes or sluggish streams.

Although they are evasive and very shy by nature, in the rutting season, bulls having fully developed antlers, make far-



FIG. 106. — DISTRIBUTIONAL RANGE OF ANTELOPE, MOOSE, AND CARIBOU IN NORTH AMERICA.

reaching calls for feminine associates, in defiance, as it were, of all rivals. Experienced hunters imitate the call with birch-bark trumpets and lure the most aggressive and superior bulls to their death.

Moose have been exterminated in many parts of their natural range, but through wise protection they are increasing on some of the best breeding and feeding grounds.

Woodland Caribou (*Rangifer caribou*). — The woodland caribou is typified by a coarse head and large irregular antlers, rugged, heavy body and legs, and large spreading hoofs. Cari-

bou are ungraceful in appearance but possess strong individuality. Horns are present in both sexes, as in the reindeer.

Woodland caribou are found, with moose, in the northern forests of birch, alder, tamarack, and spruce, from Alaska and



(From painting by Carl Rungius.)

FIG. 107. — BULL MOOSE, THE LARGEST OF OUR SPECIES OF THE DEER FAMILY.

Canada south to Maine, northern Minnesota, northern Idaho, and British Columbia (Fig. 106). In summer their favorite haunts are semi-shaded streams, lake shores, and "wallows," where the animals delight to sun and bathe themselves.

Compared with moose and the smaller species of deer, the woodland caribou are not as fleet of foot or as cunning. They are easy prey for hunters and wolves. For this reason they have completely disappeared from the Adirondacks. Reproduction, however, is good where the animals are given reasonable protec-

tion. The cows are most commonly seen with a single calf, but occasionally there are two.

American Elk, or Wapiti (*Cervus canadensis*). — The American elk is, next to the moose, the largest member of this family (Fig. 108). The American elk is closely related to the European stag. Mature bulls weigh as much as 900 pounds. The antlers are heavy and widely branched, giving the males a picturesque and exceedingly noble carriage. The does may have one, two,



(Forest Service.)

FIG. 108. — AMERICAN ELK, OR WAPITI.

or even three fawns. The fawns are white-spotted like those of other deer. The bulls are distinctly polygamous. The smaller species, or dwarf elk of California, has characteristics similar to those of the American elk.

The American elk is said to have ranged over a country of greater area than that of the buffalo. It occupied forest and plain from sea level to above timberline (Fig. 109). Its forage requirements are much the same as those of cattle.

For a time the elk seemed to be in great danger of extermination, only a few hundred remaining. Stockmen came strongly to the rescue of the remaining breeding stock, however, and soon the herds increased. The present number in the United States is probably not less than 100,000. Between 40,000 and 50,000

of these are in Wyoming, mainly in the Yellowstone National Park and ranges nearby.

Elk take kindly to new environment. They are not shy of civilization, and seed herds should be established with much care, for they often prove costly and provoking to farmers by destroying fields and keeping cattle away from haystacks.

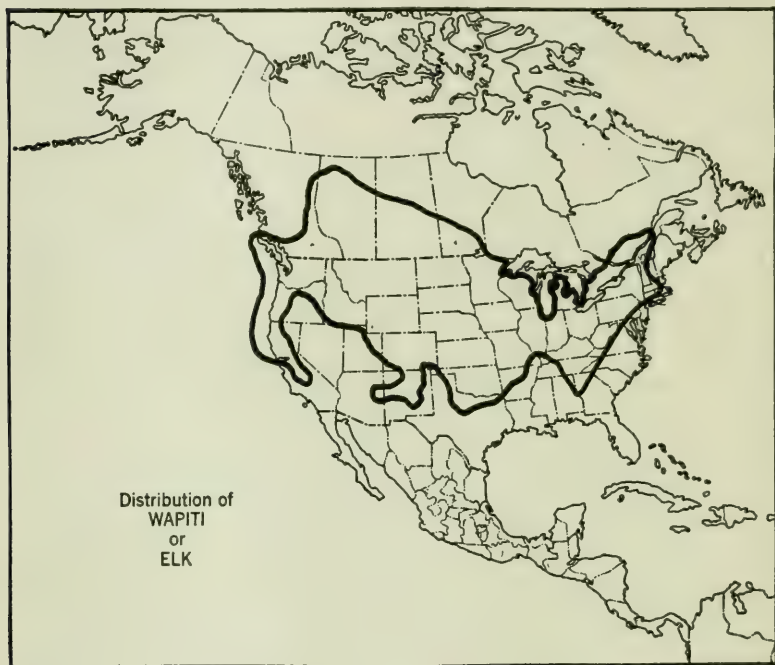


FIG. 100. — DISTRIBUTIONAL RANGE OF WAPITI, OR ELK, IN NORTH AMERICA.

Many misfortunes have resulted from stocking ranges with elk where they did not naturally occur. Many zoölogists challenge the practice of attempting to extend the range of elk or other wild mammals into areas where they are not native. Sooner or later competition for food is likely to cause complications in the reproduction and development of mammals indigenous to the locality, a condition always to be avoided.

Of greatest importance are the elk herds of the Yellowstone National Park region. The natural conditions of this region are

highly satisfactory for breeding and rearing elk. Ideal summer and fall range is available. More winter forage, however, is needed and is being provided by the Forest Service and the Biological Survey of the Federal Government. The elk problem is principally one of land control. Since the forage consumed by elk is similar to that relished by cattle and horses, the elk suffer where livestock take most of the feed. Proper balance in forage utilization by elk and by cattle must be worked out for localities where elk and cattle are competing for range. In such range-management plans it is necessary to determine the route taken by the elk between summer and winter ranges in order to locate areas where forage must be preserved. Elk are creatures of habit; they follow a general course of migration year after year.

The increase in calves is determined largely by the effectiveness of the control of predatory animals. Mountain lions, wolves, and coyotes are the worst enemies of the elk.

Deer (*Odocoileus* spp.).— Fifty or more species of deer have been described, occurring in all parts of the world except Australia and South Africa. In North America there are not less than eight species.

The distinguishing characteristics of deer are the absence of a gall bladder; lateral digits on all the feet; presence of a sub-orbital tear pit below each eye; antlers found in most species among the males only; and upper canines.

Some confusion exists in the recognition of the species of deer found in the United States. There are four distinct groups, or so-called chief species: mule deer (*O. hemionus*); black-tailed deer (*O. columbianus*); white-tailed or Virginia deer (*O. virginianus*); and Arizona white-tailed deer (*O. couesi*), (Fig. 110).

Mule deer are the most widely distributed in the West. They are considerably larger than the white-tails, with conspicuous donkey-like ears. Mature bucks have doubly-branched Y-shaped antlers; rounded, white tail with a brushy black tip; and conspicuous white rump patch (Fig. 111). The running gait is a stiff-legged jump, quite different from that of the white-tails. They range from Alberta and Manitoba, south into

Mexico, and from Iowa to California and Lower California. There are several geographic races (Fig. 112).

Black-tailed deer are similar in appearance to mule deer but are appreciably smaller. The broad, brushy, black-topped tail is a striking mark of specific distinction. They characteristic-

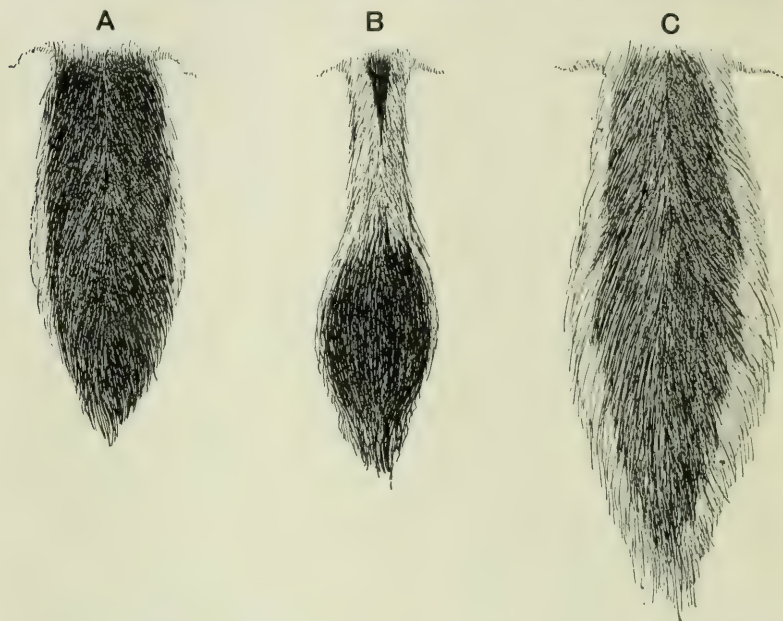


FIG. 110. — IDENTIFICATION OF SPECIES OF DEER BY THE TAIL CHARACTERS.

A. Black-tailed deer; B. Mule deer; C. White-tailed deer.

ally occupy humid, brushy and heavily forested bottom lands, from Juneau, Alaska, southward along the coast to Central California.

White-tailed or Virginia deer are well named, for when they are startled the upright, conspicuously waving, bushy tail flashes a vivid white signal with each leap. This is the typical deer of the forests in eastern North America (Fig. 113). Including near relatives, the white-tails range from Ontario to Florida, west to the Plains and the Rocky Mountains to New Mexico, and on the Pacific Coast in the Cascades and extreme Northeastern California.

The white-tails were of outstanding economic value to pioneers of the oldest of our eastern states, and even today they are the chief game animal in many localities of their natural range.



FIG. III. — MULE DEER — BUCK, DOE, AND BABES.

Note the donkey-like ears and the double-branched Y-shaped antlers.

The three species here mentioned may be readily identified by tail characters. The mule deer have a round white tail with black tip, and a conspicuous white rump patch; the white-tails have long bushy tails, the under side and lateral fringe being conspicuously white; the black-tails have dark hair on the upper surface of the tail except for a fringe of light hairs near the tip.

Arizona white-tailed deer are restricted to southern Arizona, southern New Mexico, western Texas, and certain mountains in northern Mexico. They are small and limited in distribution, hence economically much less important than the other three species.

The foraging habits of deer are somewhat the same as those of sheep. Most species and races of our deer do well on rugged

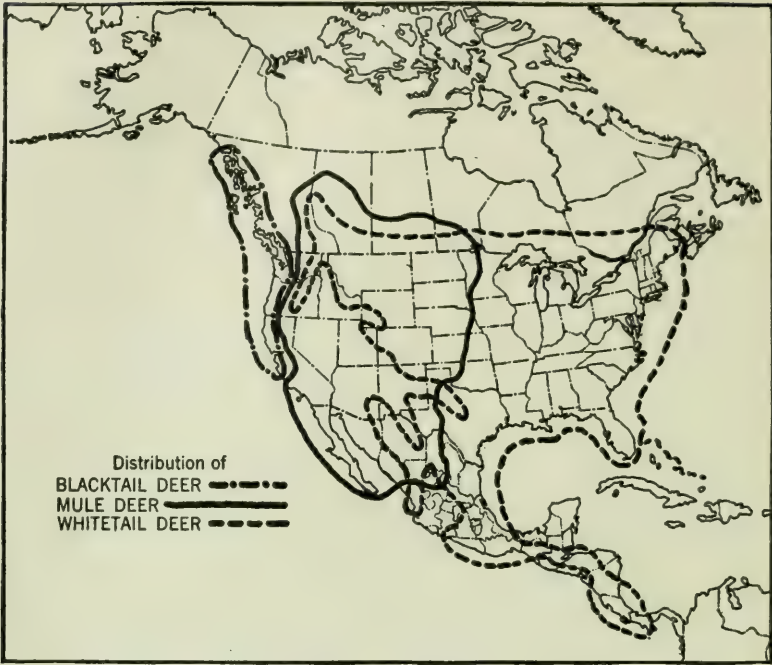


FIG. 112. — GEOGRAPHICAL RANGE OF OUR MORE COMMON SPECIES OF DEER.



FIG. 113. — WHITE-TAILED OR VIRGINIA DEER.

range and prefer an admixture of tender grasses, broad-leaved herbs, and browse. They devour a much larger proportion of browse than cattle, and it is highly important that their food preferences be kept in mind in providing range for them.

There is little difference in the reproductive capacities of our deer. The fawns, one or two from each doe, are dropped in the spring when forage is succulent.

ESSENTIAL FACTORS IN GAME PRODUCTION

Yearlong Range Necessary.—The outstanding problem of range adjustments between big game and domestic herbivora is similar to that concerned with the elk-herd management in the Yellowstone National Park and adjoining territory.

On the National Forests adjoining the Yellowstone National Park there is sufficient summer range for the elk and the domestic livestock. Both classes of stock, however, require more winter forage than is produced on the lower lands. The preservation of a large elk herd is dependent upon preventing losses from starvation in winter.

The problem is how to provide winter feed for the elk in a region where the winter range suitable for elk is fully occupied by cattle. In 1927 there were approximately 50,000 elk in this region. It is the present aim that this range be maintained as a somewhat consolidated area for the great elk herd of this country, to be used for hunting and for restocking other lands with elk. At the same time it is not to the interest of the community to lock up the forage for the use of the elk to the extent of seriously curtailing settlement and the building of homes. With these factors in view, the Forest Service withholds from stock raisers approximately 1,200,000 acres of National Forest range immediately adjoining the Yellowstone National Park. Some stockmen contend that the elk do not need and do not use this large area. Sportsmen, on the other hand, have insisted that the area provided is not sufficient for the elk. This situation, like many others, requires that it be decided what use will be of greatest benefit to the public. A herd of elk in excess of 50,000 certainly

would not be justified. The herd now is probably too large. On the other hand, one looks upon this great elk herd with pride, and sportsmen and stockmen alike wish to maintain it permanently.

Coördination of Interests Essential. — In the development of wild game on the National Forests it should be the aim to interfere as little as possible with local livestock and other interests, commercial and otherwise. There are some who feel that game and domestic livestock should not be grazed on the same range.

"You can not make two things of the same biological predilections occupy the same space at the same time. There can not, in my understanding of the situation, anywhere or ever be a so-called "maximum" output of livestock and an ideally abundant output of wild animal life from the same area at the same time. Sheep and cattle, goats and hogs, are animals which introduce entirely new features into the organic interrelations in forests."³

It is true that competition for food is the determining factor in maintaining the desired balance in animal life, and any serious disturbance in the natural plant cover will force one or more species out of existence. The use, however, of the terms "maximum output of livestock" and "ideally abundant output of wild game life," is misleading. The range expert aims always to develop his plans of land use to produce maximum livestock *consistent* with the requirements of game animals and all other interests of the area.

Continued national management of the numerous game refuges and state game preserves will go far toward perpetuating the big game. Up to the present time, however, the lands set aside for the propagation of game are not selected on the basis of scientific study. The policy is unsettled as to the number of game animals to be maintained on the various preserves and refuges, and little is known as to the extent to which these animals may ultimately conflict with local grazing and other

³ Grinnell, Joseph, "Wild Animal Life as a Product and as a Necessity on National Forests." Jour. of Forestry, Vol. 22, No. 8, Dec., 1924. Those interested in wild life and its influence on the forest are urged to read this most excellent article.

agricultural interests. Moreover, little attention has been given by the public to the bag limits and the administration of hunting regulations.

A decade ago the Forest Service took the position that the location of game preserves and the enforcement of game laws were primarily the function of the state, in which the Forest Service would coöperate. It was soon found, however, that the policy regarding the handling of game could not be shaped entirely by the state, for in many localities the interests of the public at large were not considered. Moreover, interstate game interests were involved. Now the state and the Federal governments are coöperating more or less amicably in the handling of the big game situation. The whole problem of administration and policy is seriously hampered, however, because of insufficient scientific data.

First Step in Game Propagation. — The primary requirement in the handling of the game situation is to procure a game census and the location of areas most suitable for the breeding and foraging of game animals. On many National Forests there are areas exceedingly well adapted to game which are in little demand and comparatively little used for domestic livestock grazing. Through wise management of such areas in the interest of the game, the value of the National Forests would be materially increased. Where the lands do not support an adequate breeding herd of the identical species of the former native big game, they should be introduced. Where the former species are not known, the author feels strongly that no introductions should be made. Yearlong range should in all cases be provided, but always with knowledge of the number of animals that the land will adequately support. The restocking herds should be so located on the preserve that the animals will extend themselves over the whole area in time, or else they should be placed where they will not seriously disturb other more important activities. In the study of the game problem, the U. S. Biological Survey is gathering information as to the habits and requirements of game animals, their reproductive capacities, and their adaptability to different range types — a service of primary importance.

Hunting Regulations Unsatisfactory.— Unfortunately, the statutes relating to game protection differ widely in the various states. The laws are enforced largely according to the organization and personnel back of them. A stable policy should be adopted, and to date this has proved possible only in the Federal Government, through the medium of the Biological Survey.

There are two broad possibilities for stabilizing the policy relative to game management. First, the Secretary of Agriculture may establish regulations for the protection of National Forests. He should be empowered to establish regulations for groups of National Forests in the various states, embodying laws of the states concerned for protecting fish and game. Federal officers could then prevent violations without coöperation with the game warden. Secondly, it could be announced to sportsmen and other users of the National Forests that the state laws would be rigidly enforced by Federal officers for the protection of game. This would permit Federal officers to take their cases directly into court. Game protection can not be carried out effectively so long as there remains a shifting policy of state game wardens.

RECREATION AREAS

Millions of people seek recreation each year on the National Forests. In many localities they are the only available natural playgrounds. Each year they become more popular for vacation-seekers. In 1917, 3,160,300 persons visited the National Forests; in 1927 the number had increased to about 12,000,000.

Forestry is concerned with the scientific management of lands. As population increases land values and land uses tend to change. The new factors which determine land uses necessitate departures from the usual practice of forestry. In some localities small tracts of forage and mature timber should be left untouched, for the returns, measured in human service, will be greater than the value of any crop that could be harvested. There are areas where the beauty of the landscape is valuable for itself, and as long as the public is willing to pay a higher price for timber and meat the economic situation must take care of itself. Certainly

the National Forests should be made to yield maximum returns in human happiness and development. Where the lands are more valuable for recreation than for any other purpose, they should be so used.

The forester must deal with all values of the woods. The American forester, like his European co-workers, must strive for reasonable balance between spiritual and material forms of forestry activities. This he must do, as far as possible, in harmony with the silviculturist, the range technician, and the landscape architect.

It is not probable that large areas now included in the National Forests need be withdrawn from commercial use for purposes of recreation. In California approximately one hundred camp and play grounds have been established. In size the camps themselves do not average more than 5 acres, but the recreation seekers have for their use vast areas adjoining the camps. The recreational areas have modest improvements, particularly for purposes of sanitation and for the convenience of the campers. Some are fenced against livestock; others are lightly grazed early in the season in order to remove inflammable growth and thus minimize the danger of forest fires. Conservative, early grazing has proved of great value in preventing serious forest fires from originating on camp grounds. Moreover, the short, fresh aftermath often improves the appearance and usefulness of play-grounds.

In the handling of its recreational and forest resources the Forest Service uses as its policy guide essentially the following:

(1) Recognition of the recreational use of National Forest lands as being of real public value, to be coördinated with all other forms of land uses. (2) Retention under National Forest management of all areas of recreational value, except where such value transcends all others to the extent of justifying separate administration. (3) Extension of recreation plans to all areas of National Forest land possessing real recreational value and in unquestionable demand by the public. (4) Coöperation in extension of healthful forms of mass recreation and improvement of public camp grounds upon National Forest lands. (5) Free

recreational use of the National Forests in so far as it has no commercial aims. (6) Continued issuance of permits for individual summer homes where they will not interfere with general public recreation. (7) Establishment upon Forest lands of various utilities needed by the public, with small rental charges. (8) Regulation of recreational use of National Forest lands to protect public health and property, and to avoid undue conflict with other Forest interests.

QUESTIONS

1. (a) How do the numbers of game and fur-bearing animals in North America at the present time compare with those in frontier days? (b) Discuss their monetary value at the present time.
2. Where are the natural breeding grounds of game animals chiefly located in the West? Why?
3. Name the more common big game animals of North America and state the family of which each is a member.
4. (a) What are the characteristics and food habits of the buffalo? Of rocky mountain sheep? Of prong-horned antelope? Of American elk? Of black-tailed deer?
5. Discuss the factors that appear essential to procuring good reproduction of game animals in general.
6. Outline the more important points that should be carefully coordinated in the use of lands that are suitable for the rearing of game animals.
7. To what extent is the setting aside of areas to be used for recreation justified?

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CHAPTER XXII

REINDEER PRODUCTION AS A RANGE INDUSTRY

Among the animals of the deer family, the reindeer (*Rangifer tarandus*) ranks first as a source of meat and clothing. The caribou and probably the elk rank second and third, respectively. As far as North America is concerned, reindeer raising is a range industry of importance only in certain parts of Alaska. In northern Sweden, Norway, Finland, Russia, and Siberia, the raising of reindeer is an historic occupation. It should be understood that reindeer are handled much like other domestic herbivora on the range, and are not game animals.

In 1891 ten reindeer were brought from eastern Siberia to Alaska. These, with other importations, formed the foundation herds of the Alaskan territory. Reindeer reproduced so well on Alaska ranges that in 1926 there were more than 350,000 head, composing 110 herds, distributed chiefly along the coasts of the Bering Sea and the Arctic Ocean. White men own approximately one-third of these herds, the Eskimos possessing the remainder. A few years ago the Biological Survey of the U. S. Department of Agriculture undertook a critical study of reindeer with a view to placing this industry on a sound economic basis.¹ A few small refrigerators were constructed and shipments of well-prepared carcasses distributed in various parts of the United States. In 1924 and 1925 more than 1,000,000 pounds of reindeer meat were exported from Alaska. The meat is well received by the public as it is fine-grained, compares favorably with beef, and is juicy and tender when fresh.

In conjunction with its study of reindeer management, the U. S. Biological Survey is investigating the conservation and

¹ Hadwen, Seymour, and Palmer, Lawrence J., "Reindeer in Alaska." U. S. Dept. of Agr., Bul. 1089, 1922. This publication and "Progress of Reindeer Grazing in Alaska," by Lawrence J. Palmer, U. S. Dept. of Agr. Bul. 1423, 1926, have served as the basis for the discussion as here presented.

propagation of the native woodland caribou herds. By crossbreeding reindeer and caribou, the size and quality of the reindeer is being improved. The average reindeer carcass weighs about 150 pounds, whereas the better caribou carcasses dress 300 pounds or more. By constructive crossbreeding and careful management, it may be possible to increase the carcass of the reindeer as much as 100 pounds or more. Since these animals are of the same genus they crossbreed readily.

Reindeer Characteristics. — The reindeer gives the impression of blockiness when prime (Fig. 114). An average-sized reindeer stands about 11 hands high and measures about 6 feet from the nose to the tip of the tail.

Two general types are recognized: a short, stocky one and the rangy, large-framed fellow. The latter type is preferable as it yields more meat and a bigger hide. The color of reindeer is variable, but usually the body is gray-white, the sides of the abdomen and the hind quarters darker, and the legs almost black. White and spotted animals are rather common. White individuals, although

not true albinos, have a poor sense of sight and are easy prey for predatory animals. Until recently no attempt has been made to curb the reproduction of white reindeer, but every effort should be made, through selective mating, to eliminate them. Animals with dark spots are not objectionable.

The temperament and disposition of any domestic animal are of great importance in its economic production. Reindeer have characteristics peculiar to sheep, cattle, and horses. "They flock together like sheep, graze more like cattle, and in intelligence and activity more nearly resemble the horse. They are much more intelligent than cattle, but not as intelligent as the horse."



(*Biological Survey.*)

FIG. 114. — ALASKA REINDEER RUSTLING THEIR DAILY RATION ON SNOWY TUNDRA.

Note the blockiness of the reindeer steer.

Reindeer are gentle and active, and can cover short distances as fast as an ordinary horse.

Female reindeer, unlike most members of the deer family, have almost as well-developed antlers as the males. The horns of the fawns are shed in the spring one year after birth. A new set of horns appears immediately after the shedding of the fully developed ones and in about ten weeks the growth of this second set is complete in both male and female fawns. The adult doe sheds her horns again at two years or more of age, a few days after the fawn is born. Males three years of age or slightly younger drop their horns after the rutting season in November.

Rate of Increase. — In Alaska the annual gross increase in reindeer varies from about 33 to 45 per cent, and the fawns from 50 to 60 per cent. This is considered a satisfactory rate of increase for the future of the herds. In Sweden the herds are increasing at the rate of about 25 per cent in normal years. The average life of a reindeer is about fifteen years. Full maturity is reached between four and five years of age, but the prime steers are produced at the age of three years. After the third year the increase in weight is slight, compared month for month.

The best time to slaughter the animals is late in the fall, for then the fat is white and firm and the animals are in the best condition. The meat of animals killed in July or early in August is soft and watery.

The Range. — Whether or not an area is suitable for reindeer grazing is determined largely by the climate, the character of the forage, and the site. The range must be in the arctic or sub-arctic regions. The summer range should be as free as possible from mosquitoes and warble flies; when these pests are serious the animals seek protection on wind-swept areas where the forage is often inferior. Ordinarily the winter range should not be near the coast, as the animals may suffer because of lack of food or even die from starvation due to heavy ice from the winter rains glazing the snow-covered vegetation. The ideal range is one on which the animals can be kept in a natural major grazing unit throughout the year. Such a unit should contain a proper balance of spring, summer, fall, and winter range.

Reindeer feed on many forage species, but they prefer succulent green plants. In the winter they subsist largely on lichens, but in the summer, sedges, grasses, broad-leaved herbs, and browse constitute their feed. The following genera contribute abundantly to the reindeer's diet: non-flowering plants, including reindeer moss or lichens (*Caladonia*), Iceland mosses (*Cetraria*), and club moss (*Lycopodium*); shrubs, particularly willow (*Salix*), *Spiraea*, sage (*Artemisia*), birch (*Betula*), and huckleberry (*Vaccinium*); broad-leaved herbs, such as valerian (*Valeriana*), lupine (*Lupinus*), and vetch (*Vicia*); grasslike plants of sedge (*Carex*), rush (*Juncus*), and cotton sedge (*Eriophorum*); and grasses, particularly bluegrasses (*Poa*), fescues (*Festuca*), and wheatgrasses (*Agropyron*).

The reindeer ranges of Alaska may be divided into three classes — dry tundra, wet tundra, and rocky areas. The grazing capacity of the dry tundra type, because of good utilization of the forage, is ordinarily higher than the grazing capacity of wet tundra. Although most of the range now used is near the coast, the interior lands offer good possibilities for the expansion of the reindeer industry. There are probably between 150,000 and 200,000 square miles of range capable of supporting reindeer. No cultural crops are used and no feeding of concentrates is practiced in reindeer production, hence a properly balanced forage, available at all seasons, is imperative. More range is needed in winter than in summer. On a yearlong basis, from 40 to 60 acres per reindeer is necessary to avoid injury from overgrazing. Of this acreage approximately two-thirds should be winter range. The Alaskan range area should eventually support 3,000,000 animals.

The adoption of improved management methods in the grazing of reindeer in Alaska has by no means kept pace with the rapid increase in the numbers of animals produced. The reindeer industry gives promise of being a highly important factor in the development of Alaska and it should be placed on a sound business basis. In general, the rules for handling livestock on the western ranges apply to the management of reindeer.

Size of Herd. — The maximum number of reindeer that may be run successfully in a herd has not been determined definitely. Too large a number of animals in a band is detrimental not only to the range, but also to the animals. On the other hand, because reindeer are not as amenable to control as sheep, the cost of herding 2000 head, which comprises a small band, is nearly as great as the cost of herding a band of several thousand head. The size of the natural range units, which is usually limited by water and topography, varies widely, but most grazing units



(*Biological Survey.*)

FIG. 115. — PART OF A HERD OF ALASKA REINDEER ROUNDED UP FOR MARKET.

support from 5000 to 10,000 animals. These units make the organization of coöperative reindeer associations desirable, and the advantages of such associations might offset the disadvantages of segregating the animals into small herds (Fig. 115).

General Range Handling. — If the best results are to be obtained, the animals, as indicated, should be adequately controlled within the various natural subdivisions of a grazing unit in order that the range may be utilized uniformly and at the most suitable season. To accomplish this, proper herding and salting are of the greatest importance. This can not be done efficiently unless enough suitable cabins are erected; and in some localities drift or division fences will be required.

Open herding, such as is practiced by the more successful sheep growers, is the best method. In the handling of reindeer, however, the herding must not be lax, for then the animals will scatter too widely and heavy losses will result from straying. The herding is done mostly on foot, although recently reindeer and sometimes horses have been introduced as a means of transportation. Dogs are used to control the animals. Bands of 5000 head usually require the services of three herders.

Reindeer are very fond of salt, hence the control of them on the range is simplified by the proper distribution of salt. Rock or block salt is used with good results, being preferable to crushed salt. In the interior little salt is available, but along the coast the animals procure it in summer by drinking sea water.

Not less than three headquarters cabins are needed on an average range unit. One of these should be located on the summer range, one on the winter range, and one on the fawning grounds. In addition, several temporary shelters should be provided at points where the animals can be handled quietly and openly.

From five to ten bucks are required for each hundred does. The bucks should be selected with discrimination, and all males not to be used for breeding should be castrated. Occasionally new blood should be introduced into the herd through the purchase of superior bucks. In breeding up the herd, the selection should extend to the females. All inferior, off-color, and aged does should be discarded.

Earmarking of reindeer, by cutting off the tip of one ear or notching one or both of them, is often used in order to establish ownership. Usually the fawns are earmarked like their mothers. The use of the same mark for all the fawns in the herd is recommended where the various owners are entitled to a percentage of the offspring in proportion to the number of does owned, as this plan lessens the work of handling the animals. Owing to the limitations of earmarkings, branding is becoming popular. Because of the heavy hair over most of the body the brand was formerly placed on the jaw, but to some extent this is being abandoned in favor of branding on the flank. Reindeer brands are registered just as stock brands are in the western United States.

Dehorning has been tried experimentally but has not proved successful.

Castration is performed successfully through the use of an emasculator, an instrument invented by the United States Biological Survey for severing the cord of the testicles. Until recently it was the custom to emasculate by crushing the testicles, a practice introduced by the Lapps. This method of castration, though still used to some extent, is inhumane and often ineffective. Spring is the best time to castrate. The operation should not be performed in hot weather, because of the presence of flies.

The average period of gestation in reindeer is 220 days, or approximately seven months and ten days. Usually the fawns begin to appear about the middle of April. During the fawning period it is imperative that the animals have plenty of green feed. The range should also have ample natural protection, such as coves and hollows, and there should be a definite fawning ground, preferably in open timber.

In the past the fawns have not been weaned, the result being that they are sometimes suckled until the next fawn is dropped. Such a practice naturally results in a weakened condition of both the doe and the young offspring. The segregation of the fawns for two or three months before fawning time, and of the breeding herd from the steers, is of great importance.

Diseases. — Reindeer are in general healthy animals, yet certain parasitic diseases and minor ailments cause some losses in the herd. Parasites are the worst enemies of the reindeer. The warble fly (*Oedemagena*) is one that may cause serious damage to the hide during the egg-laying season and much worry to the animal. The tapeworm also decreases profits from the herd, but dogs are responsible for this disease and losses from worms will disappear if the dogs are given proper vermifuge treatment. Losses from worms are minimized where deferred, rotation, and open grazing are practiced.

Animals of Prey. — The animals that prey upon Alaskan reindeer are chiefly the bear, lynx, wolf, wolverine, and eagle. The bear is the most destructive enemy. In the interior, eagles destroy many fawns. The losses from predatory animals are

not serious, although in the interior they are greater than on the coast.

QUESTIONS

1. When were reindeer first brought to Alaska?
2. (a) What are the distinguishing characteristics of reindeer? (b) What is the approximate dressed weight of mature reindeer? (c) How do reindeer compare in weight with caribou?
3. (a) What is the annual gross increase of reindeer in Alaska? (b) In what parts of Alaska are reindeer raised? (c) What is the period of gestation?
4. (a) Name the factors that determine the suitability of range for reindeer. (b) In what respect does the summer range differ from the winter range? (c) Name several plants upon which reindeer subsist. (d) Are cultivated crops and concentrates fed to reindeer during the critical foraging season?
5. (a) How many reindeer are handled in one band on typical Alaska ranges? (b) What determines the number of animals herded in one group? (c) Discuss the methods of herding.
6. (a) How much salt should reindeer be fed? (b) How many bucks should be provided for each one hundred does to procure good reproduction? (c) How are reindeer branded or marked to establish ownership? (d) Are the animals dehorned? (e) Discuss the methods used in castration.
7. (a) What are some of the common diseases of reindeer? (b) Do predatory animals cause heavy losses among the reindeer herds of Alaska? (c) Name the animals of prey that are most troublesome.

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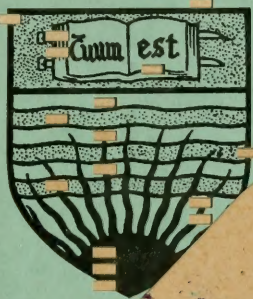
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